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SOLARTRON

Instruction Manual

for the

Digital Voltmeter

Type LM1010.2

MP MASTER

MA24404

THE SOLARTRON ELECTRONIC GROUP LTD

FARNBOROUGH · HANTS · ENGLAND

SOLARTRON

Instruction Manual
for the
Digital Voltmeter
Type LM 1010.2.

Issue : 3

Mod.Ref.: 1010.2/103

Date : May, 1963.

NOTE: This manual applies only to instruments with serial numbers subsequent to 77666.

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SECTION 1

PERFORMANCE SPECIFICATION.

Voltage Ranges, Accuracy and Resolution.	1) 0-0.15999V 10μV) ± 0.01% of reading 2) 0-1.5999V 100μV) + 1 bit 3) 0-15.999V 1mV) 4) 0-159.99V 10mV) 5) 0-1599.9V 100mV)
Thermocouple Ranges	(A) Iron/constantan 54μV bit resolution = 1°C (B) Chromel/alumel 41μV bit resolution = 1°C NOTE: An external unit is necessary to linearise the scale.
Input Impedance	Ranges 1,2,A,B. 1000MΩ Ranges 3,4 and 5 10MΩ + 0.2%
Conversion Time	20 msec Sample period on 50c/s mains 8 msec. (6.5msec on 60c/s). Digitisation period 4.5 msec.
Repetitive Sampling	At mains frequency i.e. 50 or 60 samples/second.
Resolution Control	Optional resolution of 1,2, or 5 bit to eliminate jitter caused by noise voltages or spurious signals at the input.
Polarity Discrimination	Bi-polar operation with automatic polarity switching to give a red or black background to the digital display for +ve or -ve input respectively.
Input Smoothing	Switched input filter to give 26 dB attenuation at supply frequencies.
Capacitance Transfer.	On ranges 1,2,A or B the instrument will measure, with the appropriate specified accuracy, the instantaneous voltage on a capacitance of 1μF or greater. When sampling at mains frequency, the source resistance of the input voltage must not exceed 100Ω.

SECTION 1

PERFORMANCE SPECIFICATION

Voltage Ranges, Accuracy and Resolution

	Range	Resolution	Accuracy
(1)	0-0.15998V	20μV	0.02% ± 20μV
(2)	0-1.5999 V	100μV	0.01% ± 100μV ($13-27^{\circ}C$)
(3)	0-15.999V	1mV	0.02% ± 1mV
(4)	0-159.99V	10mV	0.02% ± 10mV
(5)	0-1599.9V	100mV	0.02% ± 100mV

Thermocouple Ranges

(A) Iron/constantan 54μV bit resolution = $1^{\circ}C$

(B) Chromel/alumel 41μV bit resolution = $1^{\circ}C$

NOTE: An external unit is necessary to linearise the scale.

Input Impedance

Ranges 1,2,A,B, 1000MΩ
Ranges 3, 4 and 5 10MΩ + 0.2%

Conversion Time

20 msec
Sample period on 50c/s mains 8 msec. (6.5msec on 60c/s)
Digitisation period 4.5 msec.

Repetitive Sampling

At mains frequency i.e. 50 or 60 samples/second.

Resolution Control

Optional resolution of 1,2, or 5 bit to eliminate jitter caused by noise voltages or spurious signals at the input.

Polarity Discrimination

Bi-polar operation with automatic polarity switching to give a red or black background to the digital display for +ve or -ve input respectively.

Input Smoothing

Switched input filter to give 26 dB attenuation at supply frequencies.

Capacitance Transfer

On ranges 1,2, A or B the instrument will measure, with the appropriate specified accuracy, the instantaneous voltage on a capacitance of 1μF or greater. When sampling at mains frequency; the source resistance of the input voltage must not exceed 100Ω.

Modes of Operation	MANUAL. Single-shot operation initiated by panel push button remote contact closure, or +ve going pulse of amplitude 5V, minimum duration 1 msec. AUTO. Input repetitively sampled at mains frequency (50 or 60 samples/second)
Print-out-Facility.	Rear-mounted, 75-way socket giving decimal signal output at -12 volts. Full Wave rectified a.c. with polarity and decimal point indication. Print command signal by -10 volts pulse of duration 2 msec.
Remote Display.	A remote digital display unit can be driven from the 75-way printer socket providing the local display is removed.
Temperature Rating.	5°C to 40°C ambient.
Power Requirements.	100 - 125V/200-250V, 50/60 c/s
Power Consumption	80 VA.
Overall Dimensions and Weight.	Height 10 ins. 25.4 cm. Width 18 ins, 45.8 cm. Depth 16 ins. 40.6 cm. Weight 50 lb. 22.5 kg.

Modes of Operation	MANUAL. Single-shot operation initiated by panel push button remote contact closure, or +ve going pulse of amplitude 5V, minimum duration 1 msec. AUTO. Input repetitively sampled at mains frequency (50 or 60 samples/second)
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Power Consumption	80 VA.
Overall Dimensions and Weight.	Height 10 ins. 25.4 cm. Width 18 ins, 45.8 cm. Depth 16 ins. 40.6 cm. Weight 50 lb. 22.5 kg.

SECTION II

OPERATING INSTRUCTIONS.

Front Panel connections and controls.

Smoothing. A two position control which switches a hum filter 'in' and 'out' of the input circuit.

Input. A two pole connector, the socket is the imput signal and the plug connects to common rail.

Range. An eight position control which selects the range required. Five positions are used for the five principal voltage ranges. Two positions provide thermocouple ranges in which the voltmeter is scaled to give indications directly in degrees centigrade. The eighth position is a check position used for 'zero' and 'Calibration' checks.

Set. A three position switch which operates in conjunction with three preset potetiometers. This switch is used when the range switch is in the check position, to select zero, +ve, and -ve calibration voltages.

Manual. A push button switch which is pressed to obtain a reading when the voltmeter is operating in the Manual Mode.

Mode. A four position control which selects Manual or Auto operation. There are three Auto positions with resolutions of 1 bit, 2 bits, and 5 bits.

Mains-On. A toggle switch which controls the mains supply to the instrument.

Rear Panel Connections and controls.

Fuse. A fuse in the live side of the mains input provided to protect the power supplies under fault conditions.

Mains Cable. A three core cable for connecting the instrument to the supply main. The colour code adopted is Red-live: black-neutral: green-earth.

Mains Voltage Selector Panel. A panel which selects the required tappings on the primary of the mains transformer to match the input mains supply.

PRINTER. A seventy five-way socket connected in parallel with the internal socket feeding the indicators. This socket carries full decimal information.

REF.OUT. A six-way socket connected to resistors in the reference chain. This socket permits the use of external reference resistors for linearising thermocouple ranges etc.

MAINS EARTH/EXTERNAL EARTH. A toggle switch which is connected between the common rail and chassis, and isolates the common rail in the 'ext.earth' condition closing the circuit from common rail to chassis in the 'Mains earth' condition. Whenever possible, the common rail should be connected to mains earth by the MAINS EARTH/EXTERNAL EARTH switch on the rear panel. If the common rail is left floating completely, the instrument will not work correctly. The external earth position of this switch is provided to allow the common rail to be connected to mains earth through an external circuit to avoid earth loops. If it is desired to operate the instrument isolated from earth, the switch should be thrown to the external earth position a 1 μFd capacitor connected between common rail and mains earth. Maximum voltage between common rail and mains earth to be not more than 400 volts.

WARNING. When the switch is in the mains earth position, care must be taken not to connect the black wire on the input lead to a power source which is referred to main earth; otherwise damage will be caused to the digital voltmeter.

INPUT. A two-pole connector wired in parallel with that on the front panel.

EXT.SAMPLE. A three-pin socket, into which 'digitise' command signals may be fed either as a pulse or by closing a pair of contacts.

INSTALLATION INSTRUCTIONS.

1) General Use as a bench voltmeter.

On receiving the instrument, check for superficial damage, set the mains voltage selector panel at the rear of the instrument, to the setting nearest to the declared nominal supply voltage. Connect a three pin plug to the mains cable following the convention, Red - live : Black - neutral : Green - earth.

Extract the signal lead from the white cotton postal bag in which it is supplied, and carefully mate the free connector with the fixed input connector on the front of the instrument. The colour code on the connection lead, is Red - signal : Black - Common rail :

2) Use with external indicator or print out.

When an external indicator is used, it may be connected to the Printer Socket, but the internal display unit must be removed to avoid overloading the switching transistors. When using a print-out device, connection is made through the 75 way printer socket. An intermediate unit may be required to smooth the output supply or change its voltage to meet the requirements of the external unit.

The connections to the printer socket are as follows:

Pin No.	Signal.
1	1/0
2	1/1
3	
4	
5	2/0
7	2/1
8	2/2
10	2/3
11	2/4
12	2/5
13	2/6
14	2/7
15	2/8
16	2/9
17	3/0
18	3/1
20	3/2
21	3/3
22	3/4
23	3/5
24	3/6
25	3/7
26	3/8
27	3/9
28	4/0
29	4/1
30	4/2
31	4/3
32	4/4
33	4/5
34	4/6
35	4/7
36	4/8
37	4/9
38	5/0
39	5/1
40	5/2
41	5/3
42	5/4
43	5/5
44	5/6
45	5/7
46	5/8
47	5/9
48	
49	
50	Polarity +ve
51	Polarity -ve
52	C/R
53	C/R

Pin No.	Signal.
54	1 Decimal pt.
55	2 Decimal pt.
56	3 Decimal pt.
57	4 Decimal pt.
58	5 Decimal pt.
59	
60	Print Command.
62	Lamp Supply (-12V)
63	+40V dc stabilised
64	-10V dc stabilised
65	
66	
67	
70	
71	
72	
73	
74	
75	
76	
77	
78	
79	
80	
82	

NOTE: 2/5 indicates number 5 on the second indicator.

When a signal line is energised it moves negative to -12V DC (unsmoothed)

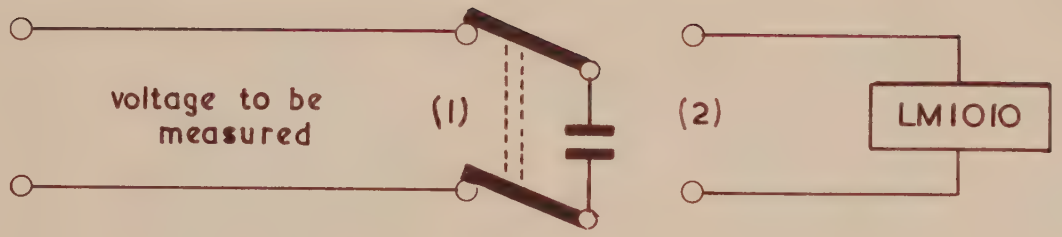


FIG 1 CAPACITANCE TRANSFER CIRCUIT

3) Use in a system.

Fit the instrument into the required position in the system. Set the mains selector panel to the nominal system supply voltage. Connect the supply cable to the system mains supply. Connect the printer socket through a suitable intermediate unit to the printer using the connections previously listed. Connect the signal input lead to the input socket (front or rear as required).

If the instrument is working in an automatic sampling system, connect the sample command signal to the external sample socket.

If the system has a power switch controlling all units, set the power switch on the front of the instrument to 'on'. Set the earth switch on the rear of the instrument to ext. earth unless it is desired to earth the whole system in the voltmeter, when the switch should be set to Mains earth.

Operating Instructions.

Switch on the instrument and allow 30 minutes for it to reach a stable operating temperature.

Set the range switch to 'check' smoothing to 'out', mode switch to 'auto 1', and the lever switch to the 'zero' position. Note the reading on the voltmeter which should be 00000 with a black background, if necessary adjust the relevant screw-driver control to obtain this reading as follows. First move the potentiometer clockwise to obtain a reading on a red background, then slowly move it counter clockwise until the indication changes to 00000 with a black background. Do not turn beyond this point.

Set the lever first in the upper position, and then in the lower position. In each case, the voltmeter should indicate the voltage shown on the label to which the lever is directed.

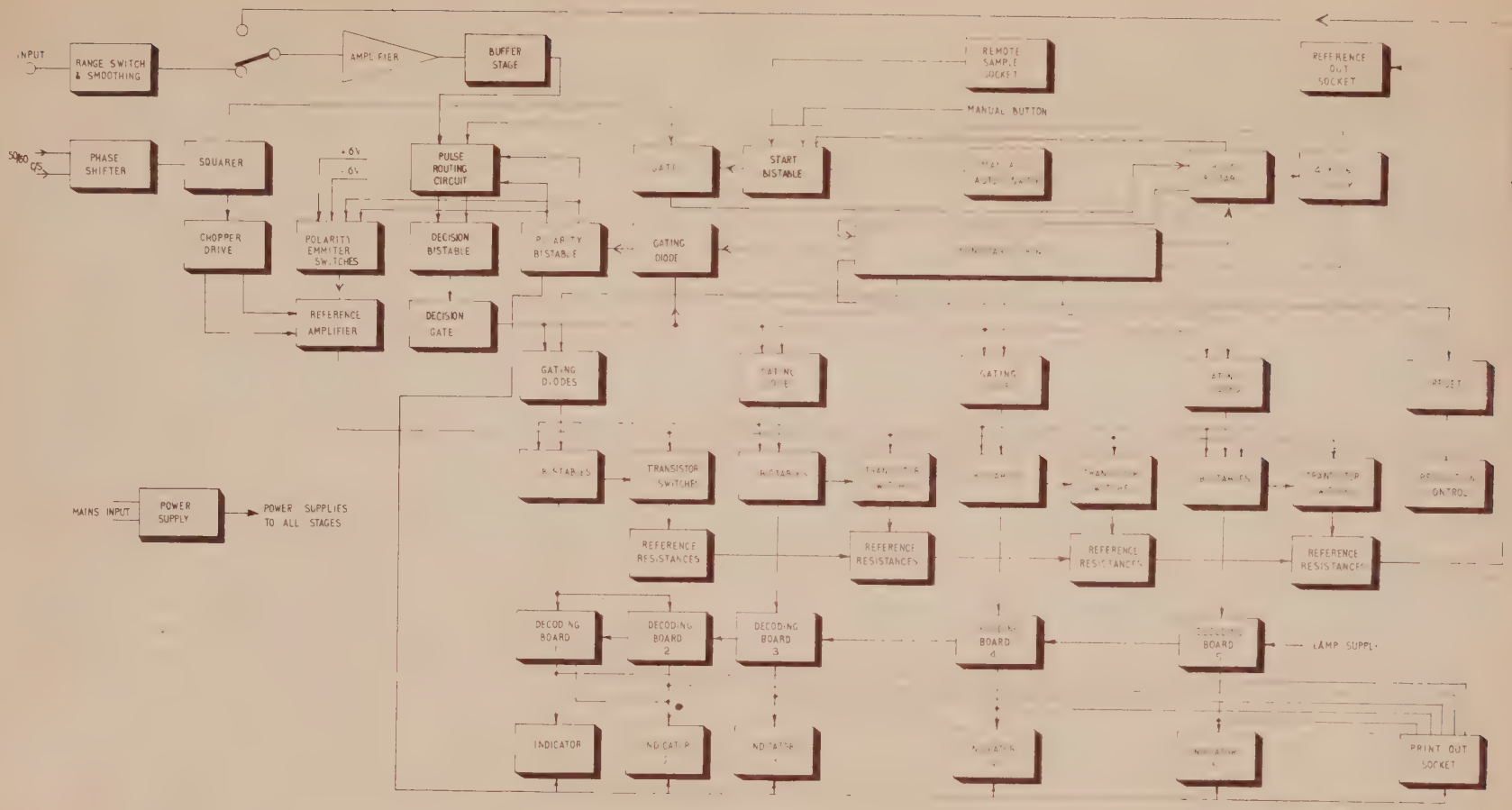
If these readings are not correct, adjust the relevant screw-driver controls to obtain the required readings.

To monitor a steady d.c. voltage, set the range switch to the 1500V range and the mode switch to Auto 1. Connect the input lead to the voltage to be measured. Turn the range switch counter clockwise, increasing the sensitivity of the instrument until the reading occupies the maximum number of windows or the maximum sensitivity is reached. Note that the first window can only read 0 or 1.

The 'Ref Out' Socket at the rear of the instrument provides access to the reference resistor chain in the instrument. This permits linearising components to be added to the chain if required, e.g. when the instrument is working in conjunction with thermocouples.

One digit on the fifth indicator, on the 0.15V range, represent an input signal of 10μV. On the thermocouple ranges A & B, one digit on the fifth indicator represents an input signal of 54 and 41μV respectively. The voltmeter thus reads directly in degrees centigrade.

The input impedance of the voltmeter on the thermocouple ranges, and on the two most sensitive ranges, is greater than 1,000MΩ. A capacitance transfer system of measurement can therefore be used to eliminate any common mode voltages. Capacitance transfer can be done quite simply with a 1μFd capacitor and a very low leakage double-pole switch connected as shown. When the switch is in position (1) the capacitor


INPUT
RANGE SWITCH & SMOOTHING
AMPLIFIER
BUFFER STAGE
REMOTE SAMPLE SOCKET
REFERENCE OUT SOCKET
MANUAL BUTTON
PHASE SHIFTER
SQUARER
+6v
-6v
PULSE ROUTING CIRCUIT
START BISTABLE
CHOPPER DRIVE
POLARITY EMMITER SWITCHES
DECISION BISTABLE
GATING DIODE
REFERENCE AMPLIFIER
DECISION GATE
GATING DIODES
TRANSISTOR SWITCHES
REFERENCE RESISTANCES
DECODING BOARD 1
DECODING BOARD 2
DECODING BOARD 3
INDICATOR
MAINS INPUT
POWER SUPPLY
POWER SUPPLIES TO ALL STAGES
PRINT OUT SOCKET

charges to the voltage being measured. When the switch is set to position (2) the voltage on the capacitor is measured by the voltmeter. The switch can be manual or relay operated.

SECTION III

PRINCIPLES OF OPERATION.

This section should be read in conjunction with the block diagram Fig.2. Voltage measurement is by a process of successive approximation. The voltage to be measured is connected through an input attenuator to a drift corrected differential amplifier, where it is compared with a reference voltage which can be varied in discrete steps. The output from the amplifier is a function of the difference between the input voltage and the reference voltage, and the amplitude and polarity of the output operates a gate which determines whether each discrete increment of reference voltage is accepted or rejected.

The increments in reference voltage are controlled by transistor switches, operated from a monostable ring through bistables. The monostable ring is a 19-position ring circuit, which switches successively from stage to stage as it is triggered from a 4 kc/s clock circuit. The ring may be considered to have one stable state and 18 astable states.

When the digital voltmeter is working in the auto mode, the ring cycles once in every 20 msec. When however, the digital voltmeter is operating in the manual mode, a cycle may be initiated by energising the external sample socket, or by pressing the manual button. The cycle of operation

is then as follows:-

When the manual button is pressed or the remote sample socket is energised, or the manual/auto switch is set to auto, the start bistable is biased into one of its stable states, so that the gate circuit to which it is connected is open. A 50 - 60 c/s supply from the mains transformer is passed through a phase shifter into a squaring circuit, and the output from the squarer is passed into the bistable controlled gate. The first positive-going edge, after the bistable has operated, passes through the gate to trigger the 4 kc/s oscillator and the ring circuit.

The monostable ring then performs one complete cycle triggered by the 4 kc/s clock. At the end of the cycle, a signal from the ring stops the 4 kc/s clock, and resets the start bistable, except in the auto position, where the start bistable is permanently biased in the running position.

A phase shift is applied to the 50-60 c/s wave before it is squared to ensure that the monostable ring cycle does not start until the chopper relays of the amplifier, driven from the same power source have time to settle.

The first stage in the monostable ring operates the polarity bistable through a gating diode and simultaneously triggers the reset circuit which sets all the ring bistables in the zero condition. Output from the amplifier passes through a storage gate and storage bistable into the

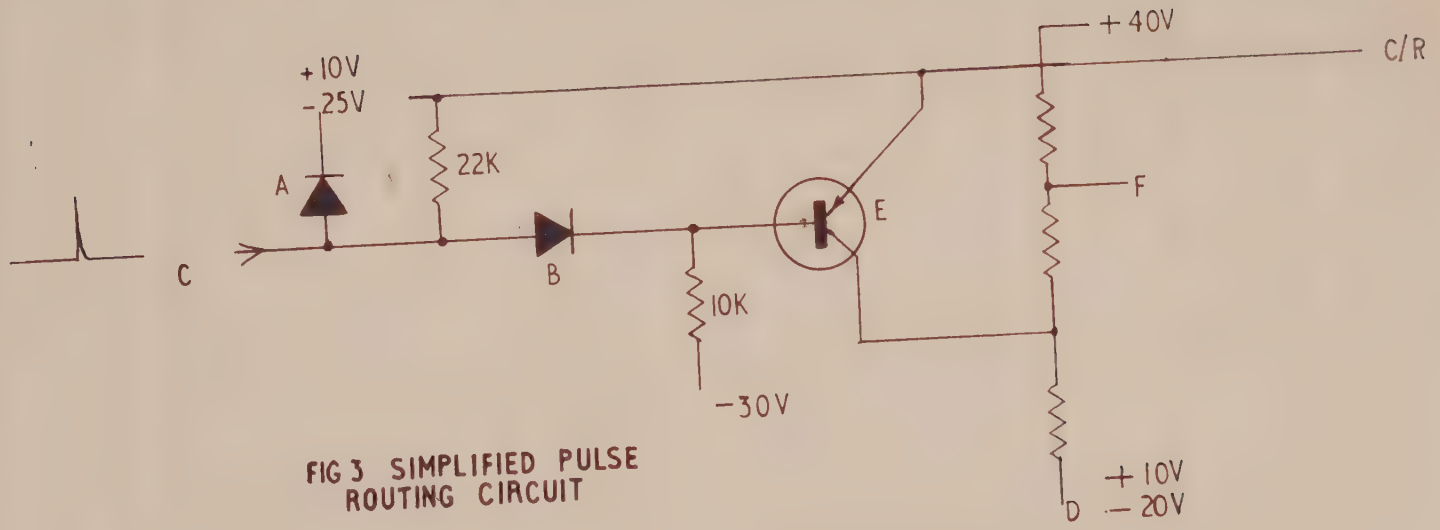


FIG 3 SIMPLIFIED PULSE ROUTING CIRCUIT

decision gate. The polarity of this output will depend on the polarity of the input, and will set the storage bistable to one side or the other. According to the setting of the storage bistable, the polarity bistable will either remain in the 'on' Position to which it was set by the monostable ring, or will return to its original stable state (off) when the monostable ring switches to the next stage. The second position of the monostable ring is blank, and provides a rest period of approximately 250 μsec during which the reference amplifier settles down after the polarity bistable has operated. The remaining 16 monostable positions each operate a bistable which controls a transistor switch. Each transistor switch connects discrete increments of reference voltage into the amplifier.

The discrete steps which are added in, are of respectively 8000 units, 4000 units, 2000 units, 1000 units, 800 units, 400 units, 200 units, 100 units, 80 units, 40 units, 20 units 10 units, 8 units, 4 units, 2 units, 1 unit.

As each increment of reference voltage is connected to the amplifier, it will modify the output from the amplifier. If the reference voltage becomes equal to, or remains less than, the voltage to be measured, the output from the amplifier will not change in polarity and the signal fed through the storage gate, will hold the storage bistable in such a position as to keep the decision gate closed and accept the increment. If however, the reference

voltage exceeds the input voltage, the polarity of the output from the amplifier will change. The storage bistable will switch over, the decision gate will then release the bistable to its original state, the transistor switch will then connect to earth and that increment of reference voltage will be rejected and disconnected from the amplifier. Thus the reference voltage approaches the input voltage by a sequence of successive approximations.

To prevent any risk of ambiguous readings, interlocks are provided on the bistables which control the 100's, 10's and units, such that if the 'eight' bistable is accepted, the 'four' and 'two' bistables are automatically rejected, thus the maximum accepted increment on each of these decades is nine.ɜts of units.

In addition to driving the transistor switches, two outputs are taken from each bistable to a matrix of diodes which decodes the information from binary decimal to decimal. The decoded signal then operates a transistor switch which is used to illuminate the required lamp in the display unit.

Parallel outputs are taken from the decoding boards to a socket at the rear of the instrument, from which decimal information may be taken to drive a remote display or a print-out machine.

The use of transistor switches to control the increments of reference voltage requires a high power, low

impedance reference source. This is obtained by feeding a reference voltage into a chopper controlled reference amplifier. The amplifier then provides the current output required for the transistor switches.

SECTION IV

CIRCUIT DESCRIPTION

The Input Attenuator (Ref.Fig.11 at the rear of the book)

The voltage to be measured is fed through a connector (SKT1) on the front panel, or through a similar connector (SKT2) on the rear panel, to the wiper (pin 12) of S1/1R. On the two most sensitive ranges, and on the two thermocouple ranges, the voltage is connected through R46 to S1/2R, and through the wiper (pin 12) to a fixed contact of the chopper relay RL1.

On the remaining three ranges, the voltage to be measured is connected into a simple ladder attenuator having a total resistance of 10 MΩ. S1/2R is then used to select attenuations of 1/10th, 1/100th, and 1/1000th on the 15V, 150V and 1500V ranges respectively.

The filter switch S3 connects C12 into the 10 MΩ ladder attenuator, and C11 to R46. This provides approximately 20 dB of attenuation of 50/60 c/s hum regardless of which range is selected by S1.

The Input Amplifier (Refer to Board 20 on Fig.11 at the rear of the book). The input amplifier consists of two electrometer pentodes (V1 and V2) connected as a cathode-coupled differential amplifier, feeding balanced signal into a double triode (V3) connected as two cathode followers. Input signal from the voltage to be measured is connected to the grid of V1 when the chopper relay (RL1) is in the

'input' position (Pin 2 to Pin 1). During this time the grid of V2 is connected through the second chopper relay (RL2) to the output of the main amplifier forming a feedback loop. The voltage fed back to the grid of V2 will be equal in amplitude to the sum of the input and drift voltages and this voltage is stored on C6.

When the two chopper relays RL1 and RL2 change to the 'reference' position, the grid of V1 is connected to the variable reference voltage, and the grid of V2 is isolated. The signal at the grid of V2 is then the voltage which was stored in C6. This voltage contains the drift component of the signal in such a phase as to provide drift correction. The relays RL1 are energised by a 6.3V AC supply from the mains transformer T1. The balanced output is taken from the anodes of V1 and V2 and fed to the grids of V3 a double triode. Outputs are taken from the cathodes of V3 to feed the main section of the amplifier.

The Main Amplifier (See Board 19 on Fig.11 at the rear of the book)

The main amplifier consists of three pairs of transistors (VT1-6) connected as emitter coupled differential amplifiers in cascade. The first pair VT1, and VT2, receive signal on their bases from the cathodes of the double triode V3. Balanced output is taken from the collectors of these two transistors to feed the bases of VT3 amd VT4 the second emitter coupled differential amplifier. Balanced outputs are taken from VT3 and VT4 to feed the bases of VT5 and VT6.

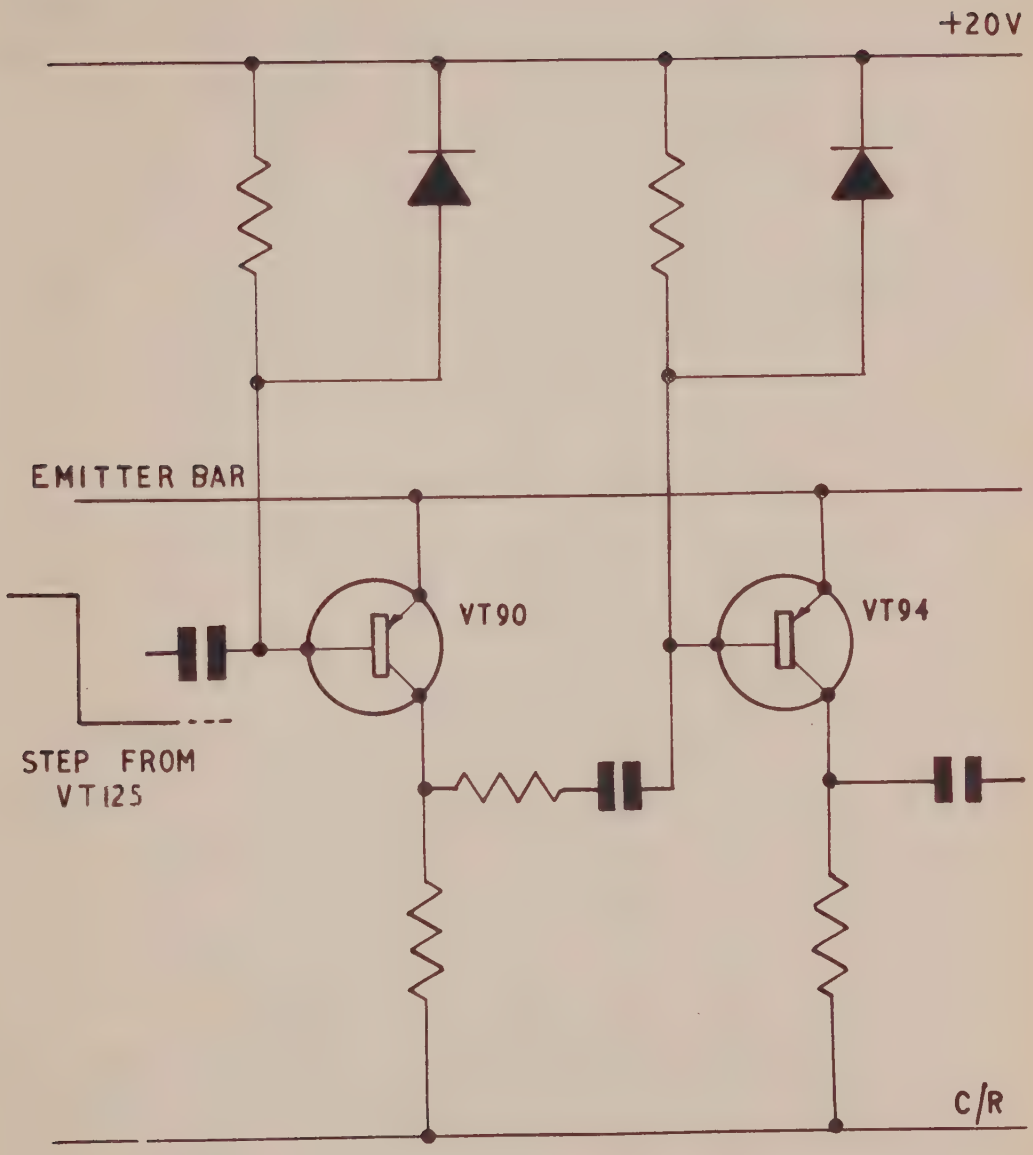


FIG. 4.
SIMPLIFIED RING CIRCUIT

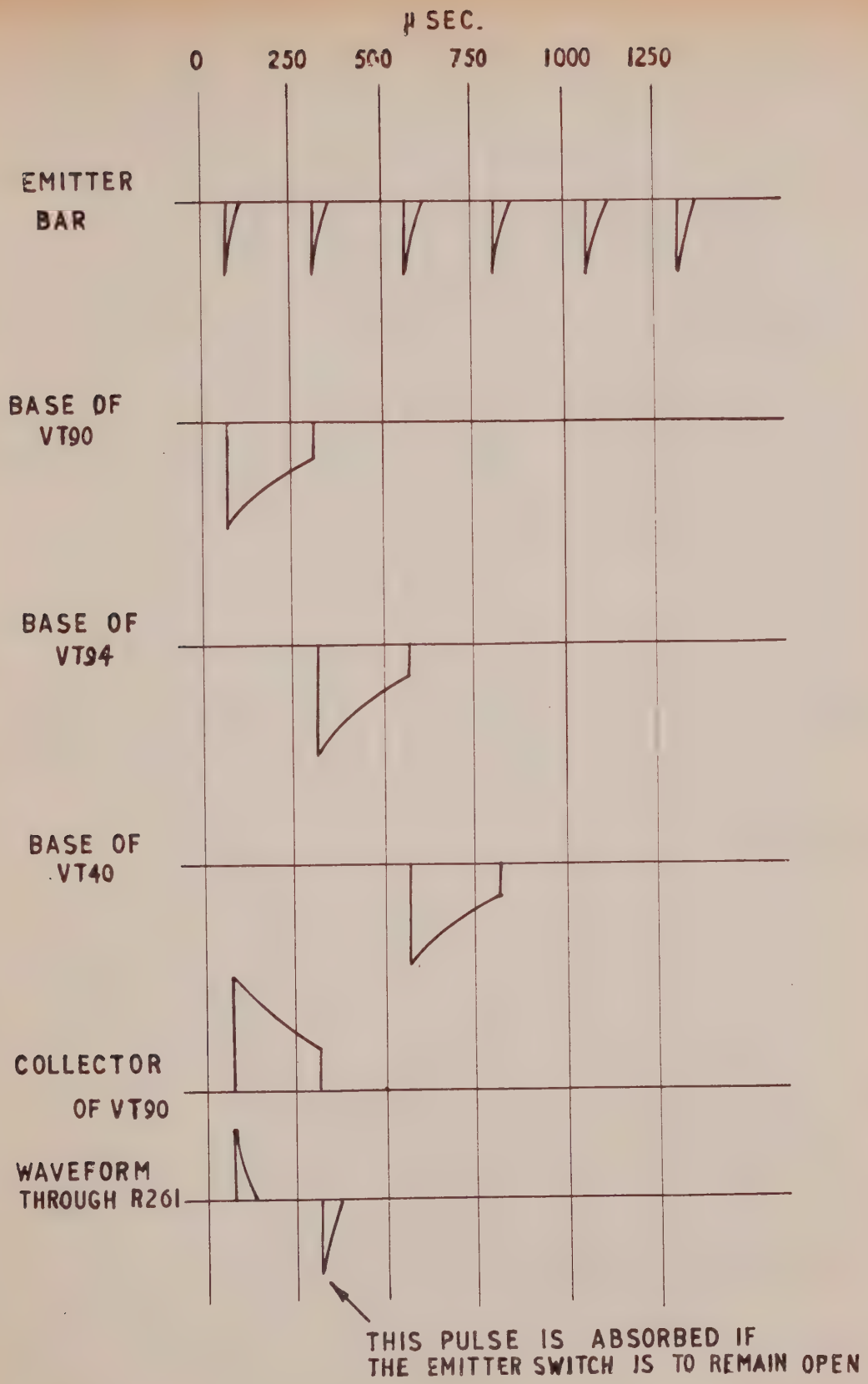


FIG 5
RING WAVE FORMS

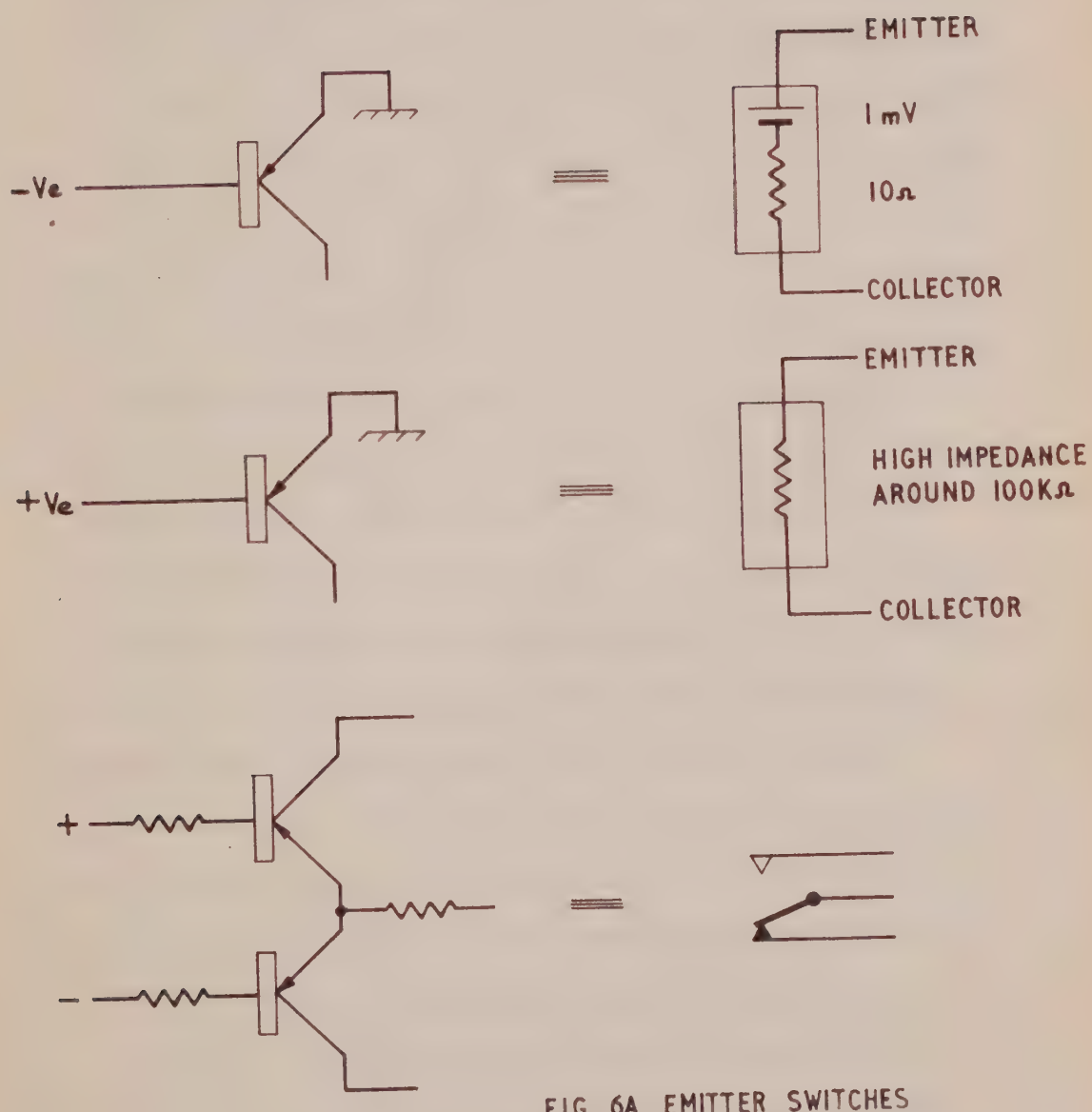


FIG 6A EMITTER SWITCHES
SIMPLIFIED CIRCUIT

Outputs are taken from the collector of VT5 to the decision gate amplifier, and through R24 and R21, back to the grid of V2 through RL2, when the chopper relay is in the input position. The diodes MR1 and MR2 between the base and emitter of VT5 and VT6 are provided to prevent excessive reverse bias on these two transistors. Negative feedback is taken from the resistor chains in the collectors of VT5 and VT6 through R36 and R37, to the bases of VT3 and VT4. This negative feedback is provided to limit the gain of this part of the amplifier, and so reduce the effects of tolerance variations in the transistors VT3 to VT6. The effects of tolerance in the transistors VT1 and VT2 are reduced by current feedback introduced by R26 and R28. The overall gain of the main amplifier from the grid of V1 to the output at the collector of VT5 is of the order of 10^6. When the input to V1 is a positive voltage, the output from the amplifier will be positive and this will be fed back to the grid of V2 and stored on the capacitor C6. When the chopper relays change over to the reference position, there will be zero signal at the grid of V1, and a positive signal at the grid of V2. This will give rise to a negative-going output from the main amplifier which is coupled to the base of VT93 at the input of the decision amplifier.

The simplified diagram shown in Fig.3 illustrates the basic principles of the pulse routing system on which the decision circuitry is based. The free end of the diode A may be at either +10 volts or -25 volts, the free end of the resistor D may be at approximately +10V or approximately -20 volts; and a train of positive-going pulses is fed to the line C.

When the germanium diode A connects the -25 volts, current flows from the common rail through the 22k resistor and the diode A so that the junction of the diodes A and B is at approximately -25 volts. Since the base of the transistor E is returned to -30 volts through a 10k resistor, current will flow from the emitter of the transistor holding its base at approximately common rail potential, i.e. -25V so that the diode B is cut-off. In this condition positive pulses are unable to reach the base of the transistor from point C.

When the free end of the diode A is connected to the +10 volts potential, it will be cut-off, so that both sides of the diode B will be at approximately common rail potential, i.e. +10V. Positive pulses from C will then pass through the diode B to the base of the transistor E, cutting it off. While the transistor E is conducting, its collector will be at approximately common rail potential, whether point D is at +10 or -20 volts. However, when a pulse reaches the base of the transistor - to cut if off - the collector will either move to +10 volts or approximately -20 volts according to the voltage at point D. This positive or negative going pulse is coupled through the resistor to point F.

Referring now to the circuit diagram of board 11, VT99 and VT103 are each connected in a circuit similar to that just described, the diodes B being MR85 and MR90 and the diodes A being MR86 and MR89. The train of positive pulses entering at point C are from the 4kc/s clock. The clock

waveform is an asymetrical 4 kc/s rectangular wave which is negative for 200μsec and positive for 50μsec. The negative going edge triggers the ring and the positive edge triggers the decision bistable, so that an interval of 200μsecs is allowed after the reference is switched before the decision is taken.

The waveform is differentiated by C67 and R313 and the positive pulses pass through MR87 and MR88 to the pulse routing circuits.

The diodes MR86 and MR89 are connected through the emitter followers VT91 and VT97 to both sides of the polarity bistable so that when MR86 is cut-off MR89 is conducting. Thus the positive pulses from C67 will either route to the base of VT99 or to the base of VT103. The collectors of VT99 and VT103 connect to two similar chains of resistors R272, R318, R320 and R273, R319, R329. One end of each chain is connected to the collector of VT96 and moves positive to +10 volts when VT96 is conducting and negative to approximately -25 volts when VT96 is cut-off. The points F in the two resistor chains connect to the bases of VT104 and VT105, two transistors connected as a bistable circuit. This bistable controls the decision gate transistor VT107. The transistor VT98 and the diodes MR84 and MR91 are provided to prevent spurious triggering of the decision bistable VT104, VT105 by unwanted positive spikes.

The Polarity Decision with Positive Input Voltage.

When the positive signal is fed to the input amplifier, a negative voltage appears at the base of VT93 during the reference period. This negative signal is coupled through the emitter follower VT93 to the base of VT96 so that VT96 conducts, and its collector moves positive to +10 volts. When VT90, the first transistor in the ring, is triggered, its collector moves positive, coupling a positive signal to the base of VT95 which, with VT92 forms the polarity bistable. The signal from the ring cuts off VT95 and causes VT92 to conduct, so that the collector of VT92 moves positive to approximately +10 volts and the collector of VT95 moves negative to approximately -25 volts. These signals are coupled through the emitter followers VT91 and VT97 to the diodes MR86 and MR89 so that MR86 is cut off and MR89 is conducting.

The next positive-going pulse from the 4kc/s clock is therefore coupled to the base of VT99 which is then cut off. Its collector therefore moves positive causing a positive pulse to appear on the base of VT105. The positive pulse applied to the base of VT105 will cause this side of the bistable to be cut off and VT104 will then conduct regardless of which way the bistable was previously set. The collector of VT104 will therefore move positively to common rail so that the transistor VT107 is cut off. The diode MR81, connected to the collector of VT90 through C62, therefore returns to the rail through R335 a 33k resistor. When the ring steps to the next stage and VT90 is cut off, the negative-going voltage on its collector is coupled through C62 to the base of VT95

READ OUT SYSTEM

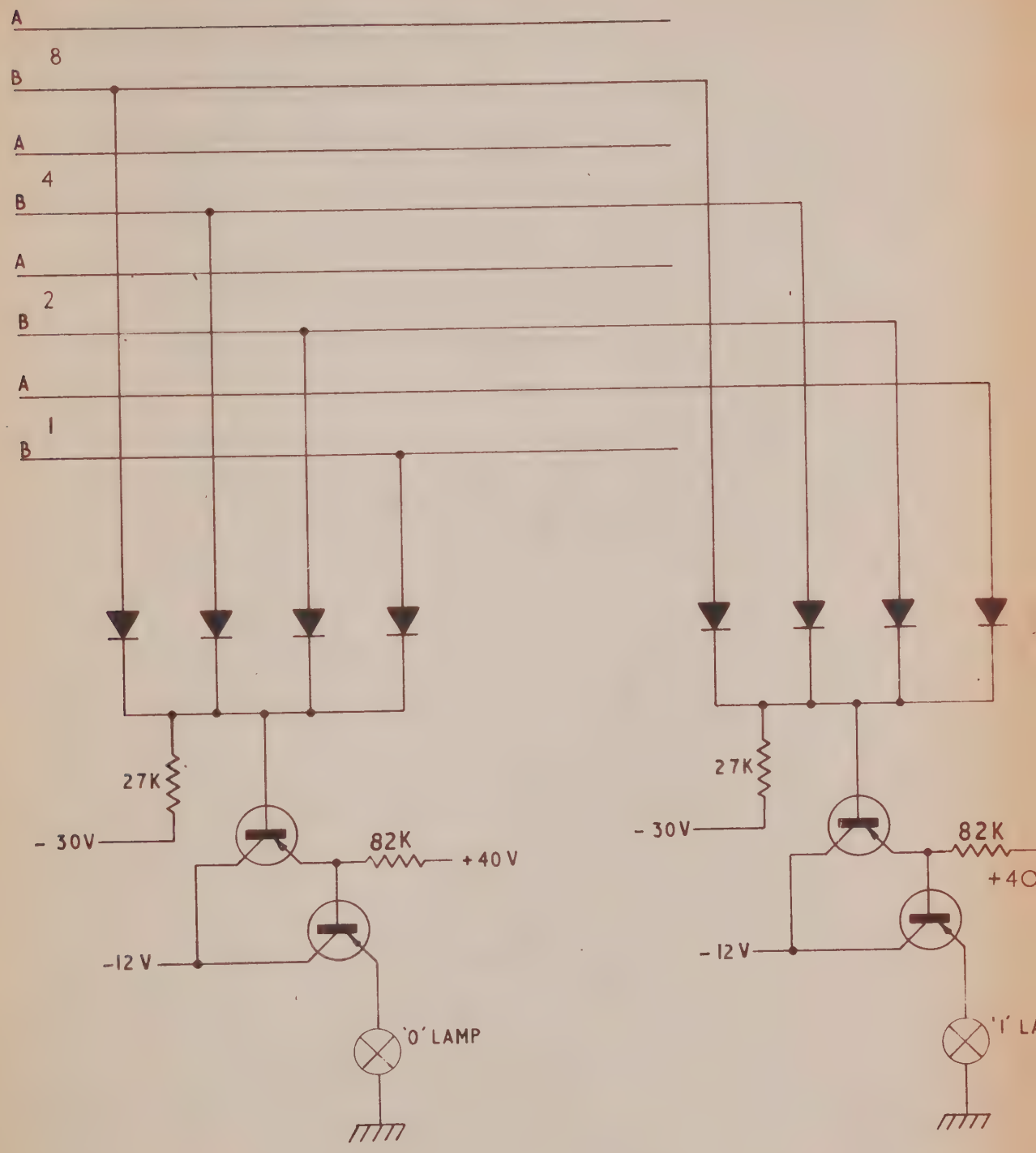


FIG 6B DIODE MATRIX '0' & '1' LAMPS.

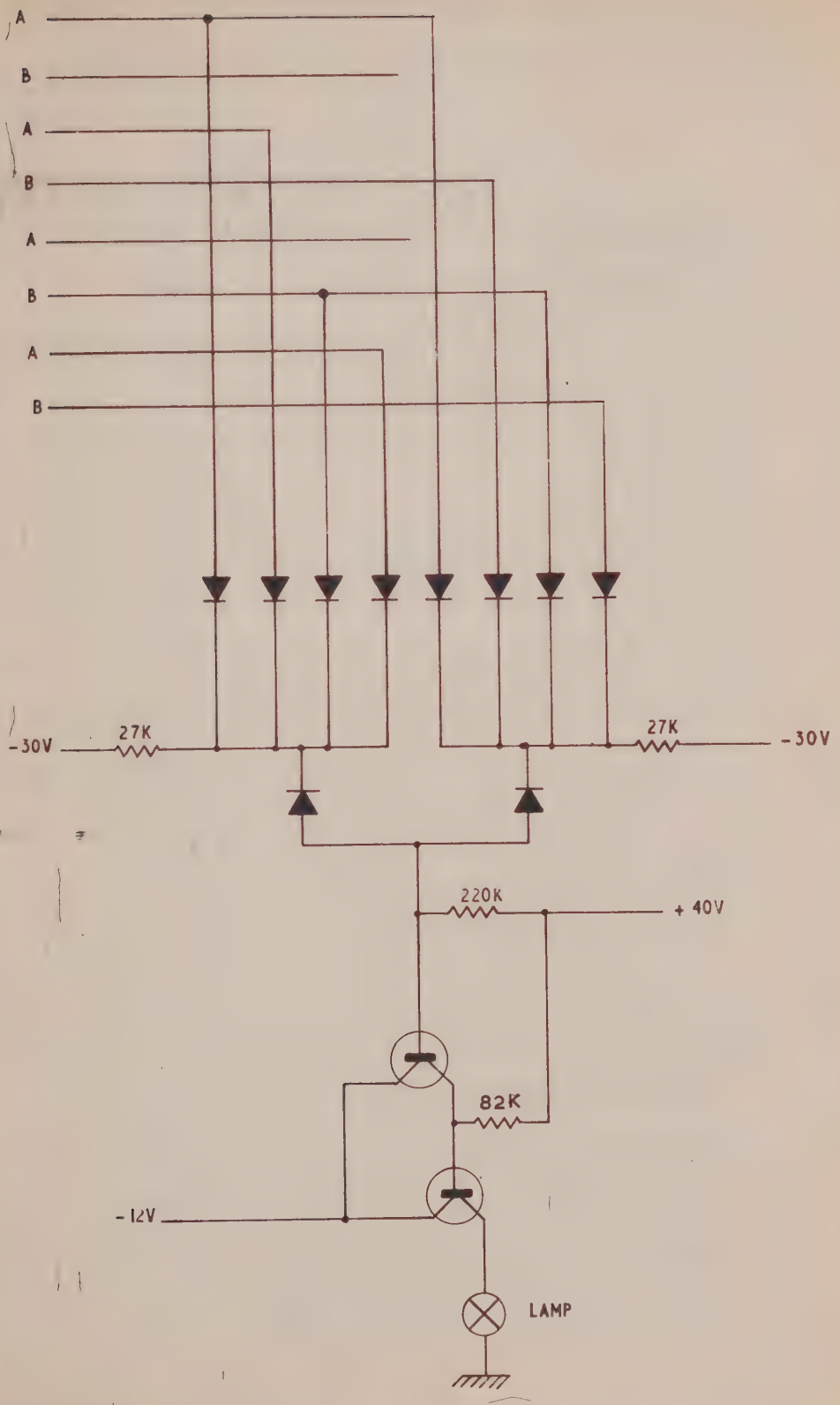


FIG 7 DIODE MATRIX SECOND INDICATOR

causing the bistable VT95, VT92 to change state. This sets up the necessary reference conditions and polarity indication for a positive input.

Polarity Decision Negative Input Voltage

If the input to the digital voltmeter is a negative voltage, the signal appearing at the base of VT93 will be positive and will be coupled through the emitter follower VT93 to the base of VT96. This will cut off VT96 and its collector will move negative to approximately -20 volts. When the ring transistor VT90 is triggered, the bistable VT95 and VT92 will set as before so that MR86 is cut off and MR89 is conducting and the next positive pulse on the 4Kc/s clock will couple through to the base of VT99 as before. However, as the collector of VT96 is negative, the collector of VT99 will move negative instead of positive when VT99 is cut off. This will cause a negative pulse to be applied to the base of VT105 so that it will conduct and VT104 will be cut off.

The base of VT107 will therefore move negatively with the collector of VT104, and VT107 will conduct. The diode MR81 is then connected to the +10V rail through the low impedance of VT107. When the ring transistor VT90 is cut off, the negative movement of the collector will cause MR81 to conduct so that the negative pulse does not reach the base of VT95. The bistable therefore stays with VT95 cut off and VT92 conducting. This sets up the necessary reference conditions and polarity indication for a -ve input. Once

the polarity decision has been made the state of MR86 and MR89 is fixed for the remainder of the ring cycle. Thus after the polarity decision with a negative input voltage MR86 will be cut-off and MR89 will be conducting, and with a positive input voltage MR86 will be conducting and MR89 will be cut-off.

Reference Decision Positive Input Signal.

When the input signal is positive going and the polarity decision has been made, the pulse routing circuit is so arranged that MR86 is conducting and MR89 is cut-off, so that the positive clock pulses are connected through to the base of VT103. At the same time the signal on the base of VT93 is negative-going, giving rise to a positive voltage on the collector of VT96. This leaves the decision bistable with VT105 cut-off and VT104 conducting. As the reference voltage is increased by discrete increments at the input amplifier it will either remain less than or will exceed the input voltage. If the reference signal is less than the input voltage the output from the amplifier will remain negative. The collector of VT96 will remain positive and the pulse on the base of VT103 will cause a positive pulse to appear on the base of VT104. This will cause VT104 to be cut-off and VT105 will conduct, thus the collector of VT104 will be at approximately -30V and VT107 will conduct connecting the gating diodes (MR86 and 89) to the +10 volt line through a low impedance. The relevant increment of reference voltage will therefore be accepted. If the increment makes the reference greater than the input voltage the polarity of

the signal out from the amplifier will change so that the collector of VT96 moves negative. The next time that VT103 is cut off therefore its collector will move negative causing a negative pulse to be applied to the base of VT104. VT104 will then conduct and VT105 will be cut off. The collector of VT104 will then move positive cutting off VT107 so that the gating diodes return to the +10 volts through the 33k resistor R335. The increment of reference is then rejected.

Reference Decision Negative Input Signal.

If the input signal is negative-going, then after the polarity decision has been made, MR86 will be cut off and MR89 will be conducting. The clock pulses will therefore be routed to the base of VT99. As increments of voltage are added to the reference it will either remain less than or exceed the input signal. While the signal is greater than the reference the voltage of the amplifier will be positive-going on the base of VT93 so that the collector VT96 is negative. Thus the pulse on base of VT99 will cause the collector to move negative applying negative pulses to the base of VT105.

The ring triggering circuits (Refer to Board 12 on Fig.12)

An output voltage from a winding on the mains Transformer (T1) is taken through C71 and R340 into the base of VT108. VT108 and VT109, together form a squaring circuit producing a 50 c/s square-wave which is phase retarded with respect to the supply from the mains transformer. As output is taken from the collector of VT109 to drive the chopper drive transistors VT127 and VT129 situated on

board 11. A parallel output is taken through C72 and R346, to the base of VT110. VT110 is the gate circuit controlled by the bistable VT115 and VT116.

The bistable may be controlled from the EXTERNAL SAMPLE socket SKT3, the MANUAL push button switch S8, or the AUTO/ MANUAL switch S2. When switch 8 is closed, C73 is discharged through R348 to common rail applying a positive pulse through the diode MR96 to the base of VT115. This causes the bistable VT115, VT116 to change state, so that VT115 is cut-off and VT116 conducts. The collector of VT116 therefore, moves positive from common rail, reducing the base current drive to VT110. This allows the next positive-going edge from the squaring circuit VT108, VT109 to cut-off VT110. The collector of VT110 then moves negative to common rail, applying a negative signal to the base of VT126, which commences to conduct. The base of VT128 therefore moves positive towards +20V, unclamping the base of VT130. VT130 and VT131 form the 4 kc/s clock oscillator, and when the base of VT130 is unclamped, this oscillator commences to operate. A 4 kc/s output is taken from the collector of VT130, through C78 to the base of VT132, the emitter follower which drives the emitter bar. The first negative pulse is coupled to the emitter of VT125, and cuts it off, further establishing the conducting condition of VT126. At the end of the cycle, signal from VT65 (Board 6) to the base of VT125, causes it to conduct. The collector of VT125 then moves

positive, and this positive movement is coupled through R391, to cut off VT126 and bottom VT128; VT128 then holding the base of VT130 clamped at common rail potential. The positive movement of the collector of VT125 is also coupled through C74 and MR97 to the base of VT116. This changes the state of the bistable VT116 and VT115 so that the base of VT110 is clamped to the common rail through R354 and R357. The output from VT109 is then not adequate to cut VT110 off.

The conditions just described apply in the MANUAL mode.

When the instrument is operating in the AUTO mode, the base of VT115 is connected through S2/2F to the +20V rail holding the bistable VT115, VT116, permanently biased, with VT116 conducting. This holds the gate VT110 permanently open, and the ring is triggered by each cycle of the 50 cycle supply. Thus the input voltage is monitored every 20 m/sec in this mode.

The 4 kc/s output from the collector of VT130 is also coupled to the base of the emitter follower VT134 which drives the pulse routing circuits (Board 11).

When VT128 conducts at the end of each cycle, the negative voltage steps applied to the base of VT130 is also coupled through C67 and MR90 to provide a negative print command pulse for an external printer.

The Monostable Ring Circuit

Sections of the monstable ring appear on Boards 10, 2, 4, 6, 11 and Board 12 on circuit diagram Fig.12.

The ring consists of the transistors VT40, VT42, VT44 and VT48 on Board 10. VT55, VT58, VT62, VT65 repeated on Boards 2, 4 and 6. VT125 and VT126 on Board 12 and VT90 and VT94 on Board 11. In the quiescent state all the transistors are cut off with the exception of VT125. The ring action commences when a series of negative going pulses from the 4kc/s clock appear on the emitter bar marked E/B. The first pulse in the train appearing on the emitter of VT125 cuts this transistor off causing a bistable action between VT125 and VT126. VT125 is therefore held cut off, and VT126 is held conducting. The collector of VT125 moves negatively, coupling a negative going step-function through C60 and R249 to the base of VT90 on board 11, this causes VT90 to conduct. C60 commences to charge exponentially through R247 towards the +20V line. The next pulse on the emitter bar cuts off VT90, causing its collector to move negative. This negative step is coupled through C61 and R251 to the base of VT94. Capacitor C61 then commences to charge through R248 and R251. A similar stepping function occurs at each emitter bar pulse, until all the transistors in the ring have been made to conduct successively. When the last transistor in the ring VT65 on Board 6 is cut off, it causes VT125 to conduct, returning the bistable VT125, VT126 to its original state, the ring then rests until the next series of pulses on the emitter bar.

A simplified circuit of a section of the ring is shown in Fig.4, and the waveforms through the section of the ring are shown in Fig.5.

The Ring Bistables (Refer to Fig.12).

Seventeen of the transistors in the monostable ring are each associated with a bistable circuit termed a ring bistable. The first, VT92 and VT95, appear on Board 11 and the remainder appear on Boards 10, 2, 4 and 6. The first bistable, consisting of VT92 and VT95 is the polarity bistable. When VT90 receives a signal on its base and conducts, its collector will move positive, and a positive differentiated signal will be coupled through R261 to the base of VT95 causing it to cut-off and making VT92 conduct by bistable action. The collector of VT95 will therefore move negatively to -30V and the collector of VT92 will move positive, thus VT97 will conduct and VT91 will be cut-off. These two transistors connected as emitter followers drive the pulse routing circuits. Outputs are also taken from the bistable to drive the polarity emitter switches on Board 18 and the polarity indicators.

The polarity indicating lamps are switched on by the compound emitter follower VT120, VT121, and VT122. If MR98 is cut-off, the base of VT120 will be negative, and the emitter followers will conduct so that the red background lamps are illuminated (positive input). When MR98 moves positive with the collector of VT92, it will conduct and the

polarity lamps will be switched off (Negative input).

When the collector of VT95 is positive, MR92 conducts and VT106 is held cut-off. If however, the collector of VT95 is negative, MR92 is cut-off and VT106 conducts. The emitter of VT106 therefore moves between +10V and -10V, and this signal is connected to Pin 51 on SKT5 at the rear of the instrument to provide negative polarity information to a printer unit. The second transistor in the ring VT94 does not operate a bistable, but merely provides a rest period during which the polarity switching transients settle down.

The next transistor in the ring VT40 controls the bistable VT41 and VT43 (Board 10). The positive-going signal at the collector of VT40 is coupled through C27 and R147 to the base of VT43. This cuts off VT43 causing VT41 to conduct by bistable action. When VT40 passes the signal on to VT42 its collector moves negative and this negative signal may be conducted down to the base of VT43, causing the bistable to return to its normal state. If however, the germanium diode MR24 is able to conduct through VT107, the decision gate during the negative pulse, the pulse will be absorbed and the bistable will remain in its energised state. The decision to reject or accept each bistable in turn depends on the voltage output from the input amplifier.

The four bistables on Group Board 10 are identical and only the first one is described. The bistables on Boards 2, 4 and 6 are similar to those on Board 10 and are operated in the same way. However, they include an interlock system

controlled by VT59 through the resistors R243, R227 and the germanium diodes MR49 and MR57. The function of the interlock system is to avoid spurious results. If the bistable VT56 and VT57 is left in the energised state, i.e. 8 units of reference voltage is accepted. MR43 moves negative allowing VT59 to conduct, this supplies a negative bias to the germanium diodes MR49 and MR57 so that the trigger pulses from the ring transistors VT58 and VT62, are absorbed by the diodes, and bistables are not operated, thus maximum reference voltage available from any set of bistables on Boards 2, 4 or 6 is nine sets of units made up of eight sets and one set.

At the commencement of each ring cycle the positive signal at the collector of VT90 is coupled through R367 to the base of VT118 cutting it off. This causes VT119 to conduct so that its collector moves positive towards +20V. This positive signal is then applied through diodes to all the ring bistables setting them in the 'off' position so that no reference signal is applied to the input amplifier at the commencement of a cycle.

The Emitter Switches (Refer. Fig.12)

The four blocks of four bistables controlled from the monostable ring operate emitter switches. These are all similar and appear on Boards 14, 15, 16 and 17. Board 17 differs from the remaining three boards in component values due to the higher value of reference current being switched. Since with this exception, all the emitter switches are

identical only one will be described. The outline circuit of this is shown in Fig.6A. The method of switching is based on the fact that a transistor when bottomed, i.e. when the base is negative with respect to emitter and collector, looks like a resistance of approximately 10 ohms in series with a generator having a potential of approximately 1mV. These constants deviate by only a small percentage and can be allowed for in calculating resistors and reference potentials. When the base of the transistor is taken positive with respect to the emitter, the transistor is cut off and looks like a high resistance of the order of 100K. The circuit configuration consists of two transistors as shown. The emitters are coupled and represent the changeover contact, the connectors of the two transistors represent the fixed contacts of the changeover switch. The bases have to be switched alternately positive and negative, and this is done from the ring bistable circuit. A single switch voltage from the ring then changes over the bistable and actuates the two transistors which replace relay contacts, thus the bistable VT41 and VT43 on board 10 feeds the emitter switch consisting of VT70 and VT71 on board 17 through the resistors R279 and R280. When VT43 is cut-off its collector moves negative to the -30V line, and VT71 conducts, this connects the reference voltage from the reference amplifier output through VT71 to the reference resistors R308 and RV20. If the bistable returns to its other state, VT43 conducts and VT41 is cut off . VT71 is then cut off,

then VT70 conducts so that the reference resistors R308 and RV20 are connected through VT70 to the common rail.

The base current for the Transistor VT71 is drawn from the reference supply. To maintain the loading on this supply sensibly constant, whether VT71 is conducting or cut off. R278 and MR62 are connected from the collector of VT71 to the collector of VT41. When VT71 is conducting, the collector of VT41 is positive and MR62 is cut off, but when VT71 is cut off, the collector of VT41 moves negative, MR62 conducts and maintains the current drawn from the reference supply sensibly constant. The increments of reference current, drawn from the reference supply through the emitter switches and the reference resistors, are added together and fed through a precision resistor chain consisting of R256, R257, R258 and R259. The reference voltage is developed across this resistor chain and increased by 100 μvolts per bit. On the 0.1 volts range, the reference to the amplifier is taken across R259 only giving increments of 10 μvolts per bit. The reference to the amplifier is taken from the junction of R256/257 or R257/R258 on thermocouple ranges giving increments of 54 and 41 μvolts/bit. These increments correspond to the outputs per ^{o}C from Iron/Constantan and Chrome Alumel Thermocouples respectively. The instrument therefore reads directly in ^{o}C on these ranges. Access to the resistor chain is provided through SKT4 so that other increments can be

provided if required.

A small amount of current, adjusted by RV24, may be fed into the precision resistor chain to offset the inherent 1mV in the emitter switches when the reference resistor is connected to C/R, and to act as a set zero control. An increment of current selected by S2/1R, equal to one half of the selected resolution, is subtracted from the reference current through R382 to provide a bias which ensures that the decision between 1 and 2 is taken at 1.5 and not at 1.999....

The Polarity Emitter Switches (Refer Fig.11)

The Polarity emitter switches mounted on Board 18 are similar to the reference emitter switches except that two emitter switches are controlled from the polarity bistable. Direct connections are taken from the collector of VT95 through R84 and R78 the the bases of VT18 and VT20 and from the collector of VT92 through R76 and R85 to the bases of VT19 and VT21. Due to the phase inversion in the reference amplifier, when a negative input signal is applied, the emitter switches connect the positive zener diode to the reference amplifier and the negative zener is used when a positive input is connected to the unit. The input resistors to the reference amplifier from the polarity emitter switches may be adjusted to compensate for tolerance on the zener breakdown voltage.

Decoding Circuits (Refer Fig.13)

At the end of each cycle of the ring, the ring bistables are left in various states, some switched on and some switched off. An output is taken from each side of each bistable to the decoding circuits. This information is in binary coded decimal form, and it is decoded by a matrix of germanium diodes. Boards 2, 4 and 6 each feed a 0-9 decoding matrix on Boards 1, 3 and 5 on sheet 3 of the circuit diagram. The simplified circuit of the matrix for the 0 and 1 lamps is shown in Fig.6B.

The operation of the circuit is as follows. If the four diodes were not present on the base of each transistor, the emitter followers would be turned on due to the negative voltage applied to the base through the 27 K resistor, thus the lamp would light. This condition also holds when the four diodes are connectedt to the negative voltages from the bistables in the ring. If however, a bistable changes state so that the diode is connected to a positive line, it will conduct, cutting off the emitter follower and extinguishing the lamp.

The diodes are so arranged in logical form that all four are connected to negative lines only when the relevant lamp should be illuminated. The following table shows the diode connections of the ten digits in a 0-9 decade. Note all the B lines are negative and all the A lines are positive at zero.

Digit	Diode Connections
0	1B, 2B, 4B, 8B
1	1A, 2B, 4B, 8B
2	1B, 2A, 4B
3	1A, 2A, 4B
4	1B, 2B, 4A
5	1A, 2B, 4A
6	1B, 2A, 4A
7	1A, 2A, 4A
8	1B, 8A
9	1A, 8A

The A and B lines are connected to the ring bistables in such a way, that for any bistable, the A line will be negative when the increment of reference is accepted and the B line will be negative when the increment is rejected. It therefore follows that if the bistables in a decade are set so that 1 bit and 4 bits of reference are accepted, and 2 bits and 8 bits are rejected, then the 'one' and 'four' A lines will be energised negative, the 'two' and 'eight' (B) lines will be energised negative, and the 'five' logic will be correctly energised for the lamp to illuminate.

The decoding in the first decade from Board 10 to Boards 9 and 8 is a little more complex, because the digits 0, 1, 2, 3, 4 and 5 in the second window, have to appear twice, i.e. they appear as 00, 01, 02, 03, 04 and 05, and also as 10, 11, 12, 13, 14 and 15. The simplified decoding for these digits is shown in Fig.7. This shows the decoding for the zero lamp in the second window. This lamp will be illuminated when the bistables on Board 10 are set for no increments of reference voltage, and also when the 'eight' and the 'two' are accepted together.

Consider first the case where no increments of reference voltage are selected by the bistables. In this condition, the four lines to which the diodes in block A are connected will all be negative, thus the junction of the diodes will be held at a voltage approaching -30V through the 27K resistor. This will cause the diode C to conduct, and the base of the emitter follower will move negative, causing it to conduct and switch on the zero lamp. If one of the bistables switch over, one of the four diodes will be connected to the positive line and will conduct so that the junction of the diodes will move positive above the common rail potential. The diode C will then be cut off, and the base of the transistor will be held positive through the 220K resistor. Similarly, when the eight and two bits of reference are selected, the diodes in block B will all be connected to negative lines, thus the junction od this set of diodes will move negative, causing diode D to conduct. The base of the transistor will again move negative, switching on the lamp. Analysis of the decoding circuit will show that if any combination of bits of reference other than the two mentioned above, is selected on this circuit, at least one diode will return to a positive voltage switching off the lamp.

The circuit sheet 3 at the end of the book shows the decoding system in detail, and lists all the connections between the decoding boards and the associated bistables.

At the commencement of ring cycle, the bistables on boards 10, 2, 4 and 6 are set to zero, and this condition

holds for part of the cycle on all boards. Thus the zero lamp on each indicator would be lit for a period between 500μsec and 3.5msec. To prevent this from occuring and causing a 'Ghost' image on the indicators, VT117 (Board 12) is connected as a zero inhibit control. The base of VT117 is connected to the collector of VT125 and is held slightly above common rail potential during the ring cycle. VT117 therefore conducts applying a positive signal through MR228 to the base of VT170 (Boards 1, 3, 5) switching off the 'zero' lights. At the end of the ring cycle, VT117 is cut off and its collector moves negative. This cuts off the diode MR228 and permits the zero lamps to light if required.

The Reference Amplifier (Board 7 Figure 11 at the rear of the book)

After the polarity bistable has made its decision, the output from the selected zener reference is connected through the relevant emitter switch to the input of the reference amplifier. The input signal is chopped at 50c/s by the transistors VT25 and VT26 which are switched in parallel and are alternatively fully conducting and cut off. Diodes MR239 and MR240 prevent parasitic oscillation of the amplifier under certain operating conditions.

The chopped input signal is fed on to the grid of the double triode V4. V4 is connected as a cathode-coupled differential amplifier to provide a high input impedance and low input noise. A balanced output is taken from the anodes of V4 to the bases of VT27 and VT28 connected as an

emitter coupled differential amplifier. Phase shifting networks R110, C25 and R116, C80, are connected between collector and base of each amplifier to preserve stability around the loop. A balanced output is taken from the collectors of VT27 and VT28 to the bases of VT30 and VT31, another pair of transistors connected as an emitter coupled differential amplifier. The germanium diodes MR237 and MR238 are provided to ensure that the reverse voltage between the base and emitter does not exceed the breakdown value, and the capacitors C81 amd C82 are phase shifting networks provided to improve the stability. An output is taken from the collector of VT30 to drive the base of VT33 an emitter follower which drives VT34 a second emitter follower. The transistor VT35 is a constant current device which provides the base current for the emitter switches and the current through VT34. Analogue negative feedback is taken from the referemce output through R100 back to the input of the amplifier and DC feedback is taken from VT31 collector, biasing the grid of the second half of V4. Drift correction is applied to the amplifier by chopping the input and feedback signals, the chopping waveform being obtained from the 50 c/s squarewave generated by VT108 and VT109 on board 12. The squarewave output from VT108 and VT109 is fed to the base of VT127 on board 11. The squarewave chops the transistor VT127 from cut-off to full conduction and back again, producing an output squarewave voltage at the collector which varies between +10V and about -20V. A portion of this squarewave

signal is applied to VT129, a similar circuit which is again chopped from cut-off to full conduction and back again, producing a squarewave output at its collector.

The waveform from the collector of VT127 also drives the feedback chopper transistor VT29, and the waveform from the collector of VT129 drives the input chopper transistors VT25 and VT26 in the reference amplifier, the two waveforms from VT127 and VT129 being in anti-phase. The input chopperu waveform is also applied to the base of VT32, when the waveform is negative going, these three transistors all conduct so that no input signal is applied to the first grid of V4, and the base of VT33 is held at C/R potential. This inhibits any disturbing feedback effects which might occur through R100. Any signal then appearing at the collector of VT31 will be due to drifts in the amplifier, this drift signal being coupled through R119 and R111 to the second grid of V4 and is stored on C24.

When the chopper squarewaves change phase, the transistors VT25, VT26 and VT32 are cut-off and VT29 conducts. This clamps the feedback signal to the second grid of V4 which is then fed with the stored drift signal thus providing drift correction on the amplifier.

Resolution Control.

The four-position switch S2 provides one MANUAL position and three AUTO positions with resolutions of 1 bit, 2 bits and 5 bits on the last window. The control is shown

in the MANUAL position.

With the resolution control set to 1, the bistables on ring board 6 work in the normal fashion to give four discrete increments of reference. When the resolution control is moved to position 2, the base of VT66 is connected through the switch wafer to the +10V supply. This holds the '1' bistable permanently biased in the off position so that only 8, 4 or 2 bits of reference can be selected. The 1 bit reference resistor R381 is simultaneously disconnected from the emitter switch, When the resolution control is set to '5', the accept/reject diodes MR42, 56, 59 in the ring at (board 9) are disconnected from the decision gate so that the '8', '2' and '1' bistables must automatically be rejected. Simultaneously MR101 which has been permanently connected to +10V is disconnected from +10V so that the base of VT133 is unclamped. The base of VT133 is still held positive by the voltage on the collector of VT61 coupled through MR100. However, when VT61 is cut-off; to select the four bit increment its collector moves negative, cutting off MR100, and permitting the base of VT133 to move negative. The transistor then conducts applying a positive voltage to the base of VT67 to set the '1' unit bistable in the 'On' position. The '1' unit is thus always selected with the '4' unit. At the same time the reference resistor for '1' unit is connected to the emitter switch which drives the '4'unit increment so that VT60 and VT61 now supply a 5 bit increment of reference and not a 4 bit increment.

In the most sensitive range of the instrument, S1/4R connects the base of VT200 to common rail through R501. This causes VT200 to conduct applying +10 volts to the base of VT66 through VT200. The 'one' unit bistable is then held permanently 'off' and the best resolution obtainable is two bits.

Power Supplies. Refer to Fig.11

Power supplies for this instrument are drawn from the mains through a switch S6, fuse FS1 and transformer tapping panel into the primary of the mains transformer T1. T1 is wound with two equal primaries of 125 volts tapped at 5, 105, 115, 125 volts. These two windings are accurately wound for use in series or parallel, so that the voltages from 100 - 125V in 5V steps or from 200 - 250V in 10V steps may be selected by suitable adjustment of the tapping panel.

The transformer has six secondary windings which supply all the power required by the instrument. The first secondary provides the indicator lamps supply through the germanium rectifiers MR12 and MR13. This supply is not normally smoothed but if a smooth DC supply is required for driving a printer or similar device, switch S5 must be set to Transformer taps 24 and 26, and capacitors to a total of 10,000µFd must be connected from the -12V supply to common rail. The capacitors can be connected between pin 62 and an earth pin on the external signal socket (SKT5) of the instrument.

The second secondary gives 6.3V centre tapped and is used to drive the two chopper relays RL1 and RL2 and to supply power to the oven heater.

The output from the third winding is rectified by MR10 and MR11 and smoothed in C18 to provide a -30V supply. The AC is also used to drive the squaring circuit VT108 and VT109 on board 12.

The output from the dourth winding is fullwave rectified in MR4 and MR5 and smoothed by C14. This gives a positive supply at +40V. VT13 and VT16 are coupled together as an emitter coupled differential amplifier (Board 13). The base of VT16 referred to the common rail through the zener diode MR18 and the base of VT13 fed with signal from the +40V line through the feedback chain R58, R59 and RV8. Variations in +40V line will give rise to a difference signal which is amplified and taken from the collector of VT13 to the base of VT14. VT14 is a second amplifier which feeds signal from its collector to the base of VT12, the series stabilising transistor. This transistor carries all the current drawn from the +40V rail.

Resistors R88 and R89 form a potential divider between the +40V and common rail, providing a potential at +20V which is fed to the base of VT23. VT23 is a n-p-n transistor which provides signal from its collector to the base of V24, an emitter follower, through which current is drawn from the +40V line to provide a low impedance voltage at +20V.

The output from the fifth winding of the transistor is fullwave rectified by MR6 and MR7 and smoothed by the capacitor C15 to provide a positive potential of 10V.

The output from the sixth winding is fullwave rectified by MR8 and MR9 into the reservoir capacitor C16. This provides a negative potential from which a stabilised supply of -10V is available. The control amplifier consists of VT17 and VT15, two transistors connected as an emitter-coupled differential amplifier. The base of VT17 is connected to the negative reference zener located in the voltage control oven. The base of VT15 is connected to a resistor chain consisting of R12, R61 and RV9, between the -10V line and the common rail. Any deviations in the -10V rail will cause a difference signal on the base of VT15 which will be amplified to create a balanced output on the collectors of VT15 and VT17. Capacitor C85 between the base of VT15 and the -10V line prevents unwanted oscillations appearing on the -10V line. This balanced output is fed to the bases of VT8 and VT10, two transistors connected as an emitter coupled differential amplifier. An output is taken from the collector of VT8 to drive the base of the series control transistor VT9.

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SECTION 6.

Components List.

Foreword.

A separate components list is given for each type of printed circuit board and for the power unit chassis. Components which are not fitted to these units are shown in the list titled Miscellaneous.

Where identical Boards are used, components for one board only are listed.

Printed Circuit Board Nos. 1,3 and 5 (Circuit Diagram Sht.3)
Solartron Part No. 555120/3

RESISTORS Class Group No.5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms.	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type.
R460	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R461	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R462	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R463	82K	10	¼	172342200	022-3028	Erie 16 Carbon.
R464	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R465	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R467	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R468	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R469	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R470	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R480	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R481	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R482	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R483	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R484	27K			172342700		
R485	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R486	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R487	82K	10	¼	172348200	022-3028	Erie 16 Carbon.
R488	27K	10	¼	172342700	022-2184	Erie 16 Carbon.
R489	82K	10	¼	172348200	022-3028	Erie 16 Carbon.

SEMICONDUCTORS

Cct.Ref.	Description.	Solartron Part No.	Manufacturer & Type.
MR198	Germanium Diode	300520210	G.E.C. GEX23
MR199	Germanium Diode	300520210	G.E.C. GEX23
MR200	Germanium Diode	300520210	G.E.C. GEX23
MR201	Germanium Diode	300520210	G.E.C. GEX23
MR202	Germanium Diode	300520210	G.E.C. GEX23

Printed Circuit Board Nos. 1,3 and 5 (Circuit Diagram Sht.3) cont'd.

SEMICONDUCTORS. (Cont'd)

Cct.Ref.	Description.	Solartron Part No.	Manufacturer & Type.	
MR203	Germanium Diode	300520210	G.E.C.	GEX23
MR204	Germanium Diode	300420210	G.E.C.	GEX23
MR205	Germanium Diode	300520210	G.E.C.	GEX23
MR206	Germanium Diode	300520210	G.E.C.	GEX23
MR207	Germanium Diode	300520210	G.E.C.	GEX23
MR208	Germanium Diode	300520210	G.E.C.	GEX23
MR209	Germanium Diode	300520210	G.E.C.	GEX23
MR210	Germanium Diode	300520210	G.E.C.	GEX23
MR211	Germanium Diode	300520210	G.E.C.	GEX23
MR212	Germanium Diode	300520210	G.E.C.	GEX23
MR213	Germanium Diode	300520210	G.E.C.	GEX23
MR214	Germanium Diode	300520210	G.E.C.	GEX23
MR215	Germanium Diode	300520210	G.E.C.	GEX23
MR216	Germanium Diode	300520210	G.E.C.	GEX23
MR217	Germanium Diode	300520210	G.E.C.	GEX23
MR218	Germanium Diode	300520210	G.E.C.	GEX23
MR219	Germanium Diode	300520210	G.E.C.	GEX23
MR220	Germanium Diode	300520210	G.E.C.	GEX23
MR221	Germanium Diode	300520210	G.E.C.	GEX23
MR222	Germanium Diode	300520210	G.E.C.	GEX23
MR223	Germamoim Diode	300520210	G.E.C.	GEX23
MR224	Germanium Diode	300520210	G.E.C.	GEX23
MR225	Germanium Diode	300520210	G.E.C.	GEX23
MR226	Germanium Diode	300520210	G.E.C.	GEX23
MR227	Germanium Diode	300520210	G.E.C.	GEX23
MR228	Germanium Diode	300520210	G.E.C.	GEX23
VT170	Transistor	300550260	MULLARD	OC.83
VT171	Transistor	300550260	MULLARD	OC.83
VT172	Transistor	300550260	MULLARD	OC.83
VT173	Transistor	300550260	MULLARD	OC.83
VT174	Transistor	300550260	MULLARD	OC.83
VT175	Transistor	300550260	MULLARD	OC.83
VT176	Transistor	300550260	MULLARD	OC.83
VT177	Transistor	300550260	MULLARD	OC.83
VT178	Transistor	300550260	MULLARD	OC.83
VT179	Transistor	300550260	MULLARD	OC.83
VT180	Transistor	300550260	MULLARD	OC.83
VT181	Transistor	300550260	MULLARD	OC.83
VT182	Transistor	300550260	MULLARD	OC.83
VT183	Transistor	300550260	MULLARD	OC.83

Printed Circuit Board Nos. 1,3 and 5 (Circuit Diagram Sht.3) Cont'd.

SEMICONDUCTORS (Cont'd)

Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type.	
VT184	Transistor	300550260	MULLARD	OC.83
VT185	Transistor	300550260	MULLARD	OC.83
VT186	Transistor	300550260	MULLARD	OC.83
VT187	Transistor	300550260	MULLARD	OC.83
VT188	Transistor	300550260	MULLARD	OC.83
VT189	Transistor	300550260	MULLARD	OC.83

Printed Circuit Board Nos. 2, 4 and 6 (Circuit Diagram Sht 2)

Solartron Part No. 555119/3

RESISTORS Class Group No.5905 Country of Origin Code 99

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref. No.	Manufacturer & Type.
R190	27K	10		172342780	022-2184	Erie 16 Carbon
R191	27K	10		172342700	022-2184	Erie 16 Carbon
R192	1500	10		172331500	022-2025	Erie 16 Carbon
R193	1800	10		172331800	022-2037	Erie 16 Carbon
R194	2700	10		172332700	022-2058	Painton 72 H.S.
R195	10K	10		172341000	022-2130	Erie 16 Carbon
R196	220K	10		172352200	022-3079	Erie 16 Carbon
R197	22K	10		172342200	022-2172	Erie 16 Carbon
R198	1800	5	2.6	173431800		Welwyn AW 3101 WW
R199	100K	10		172351000	022-3057	Erie 16 Carbon
R200	22K	5		170542200		Painton 72 H.S.
R201	1800	5	2.6	173431800		Welwyn AW 3101 WW
R202	22K	10		172342200	022-2172	Erie 16 Carbon
R203	1800	10		172318000	022-2037	Erie 16 Carbon
R204	220K	10		172352200	022-3079	Erie 16 Carbon
R205	6800	10		172336800	022-2109	Erie 16 Carbon
R206	2700	1		170432700		Painton 72 H.S.
R207	27K	10		172342700	022-2184	Erie 16 Carbon
R208	1500	10		172331500	022-2025	Erie 16 Carbon
R209	2700	10		172332700	022-2058	Painton 72 H.S.
R210	1800	5	2.6	173431800		Welwyn AW 3101 WW
R211	1800	5	2.6	173431800		Welwyn AW 3101 WW
R212	10K	10		172341000	022-2130	Erie 16 Carbon
R213	100K	10		172351000	022-3037	Erie 16 Carbon
R214	22K	5		170542200		Painton 72 H.S.
R215	1800	10		172331800	022-2037	Erie 16 Carbon
R216	220K	10		172352200	022-3079	Erie 16 Carbon
R217	22K	10		172342200	022-2172	Erie 16 Carbon
R218	1800	5	2.6	173431800		Welwyn AW 3101 WW
R219	27K	10		172342700	022-2184	Erie 16 Carbon
R220	1500	10		172331500	022-2025	Erie 16 Carbon
R221	10K	10		172341000	022-2130	Erie 16 Carbon
R222	100K	10		172351000	022-3037	Erie 16 Carbon
R223	22K	5		170542200		Painton 72 H.S.
R224	1800	5	2.6	173431800		Welwyn AW 3101 WW
R225	1800	10		172331800	022-2037	Erie 16 Carbon
R226	220K	10		172352200	022-3079	Erie 16 Carbon
R227	2200	10		172352200	022-2046	Erie 16 Carbon
R228	2800	5	2.6	173431800		Welwyn AW 3101 WW
R229	22K	10		172342200	022-2172	Erie 16 Carbon

Printed Circuit Board Nos. 2,4 and 6 (Circuit Diagram Sht.2 (Cont'd).

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type.	
R230	2700	10	¼	172332700	C22-2058	Erie	16 Carbon
R231	1500	10	¼	172331500	C22-2025	Erie	16 Carbon.
R232	2700	10	¼	172332700	022-2058		
R236	10K	10	¼	172341000	022-2130	Erie	16 Carbon.
R237	100K	10	¼	172351000	022-3037	Erie	16 Carbon.
R238	22K	5	¼	170542200		Painton	72 .S.
R239	1800	5	2.6	173431800		Welwyn	AW 3101 W.W.
R242	22K	10	¼	172342200	022-2172	Erie	16 Carbon.
R243	2200	10	¼	172332200	022-2046	Erie	16 Carbon.

CAPACITORS Class Group No.5910. Country of Origin Code 99.

Cct. Ref.	Value µFd	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type.	
C40	0.02	10	250	208350011		Hunts.	W97 BM14A MP
C41	0.0047	10	125	221334700		Wima	M Po
C42	470pF	-20 +80	500	241024700		Hunts.	Hi-K CD7K/2 Ce
C43	0.02	10	250	208350011		Hunts.	W97 BM14A MP
C44	0.0047	10	125	221334700		Wima	M Po
C46	470pF	-20 +80	500	241024700		Hunts.	Hi-K CD7K/2 Ce
C47	0.02	10	250	208350011		Hunts.	W97 AM14A MP
C48	0.0047	10	125	221334700		Wima	M Po
C49	470pF	-20 +80	500	241024700		Hunts.	Hi-K CD7K/2 Ce
C50	0.02	10	250	208350011		Hunts.	W97 AM14A MP
C51	0.0047	10	125	221334700		Wima	M Po
C52	470pF	-20 +80	500	241024700		Hunts.	Hi-K CD7K/2 Ce

SEMICONDUCTORS.

Cct.Ref.	Description	Inter-Service Ref.No.	Manufacturer & Type.	
VT55	Transistor.	300550240	MULLARD.	OC75
VT56	Transistor.	300550360	S.T.C.	TK40C
VT57	Transistor.	300550360	S.T.C.	TK40C
VT58	Transistor.	300550240	MULLARD.	OC75
VT59	Transistor.	300550360	S.T.C.	TK40C
VT60	Transistor	300550360	S.T.C.	TK40C
VT61	Transistor	300550360	S.T.C.	TK40C
VT62	Transistor	300550240	MULLARD	OC75
VT63	Transistor	300550360	S.T.C.	TK40C
VT64	Transistor	300550360	S.T.C.	TK40C

SEMICONDUCTORS (Cont'd)

Cct.Ref.	Description	Inter-Service Ref.No.	Manufacturer & Type.	
VT65	Transistor.	300550240	MULLARD.	OC75
VT66	Transistor.	300550360	S.T.C.	TK40C
VT67	Transistor.	300550360	S.T.C.	TK40C
MR40	Germanium Diode.		G.E.C.	GEX23
MR41	Germanium Diode	300520210	G.E.C.	GEX23
MR42	Germanium Diode	300520560	HUGHES	HG5009
MR43	Germanium Diode	300520210	G.E.C.	GEX23
MR44	Germanium Diode	300520210	G.E.C.	GEX23
MR45	Germanium Diode	300520210	G.E.C.	GEX23
MR46	Germanium Diode	300520210	G.E.C.	GEX23
MR47	Germanium Diode	300520210	G.E.C.	GEX23
MR48	Germanium Diode	300520560	HUGHES	HG5009
MR49	Germanium Diode	300520210	G.E.C.	GEX23
MR50	Germanium Diode	300520210	G.E.C.	GEX23
MR55	Germanium Diode	300520210	G.E.C.	GEX23
MR56	Germanium Diode	300520560	HIGHES	HG5009
MR57	Germanium Diode	300520210	G.E.C.	GEX23
MR59	Germanium Diode	300520560	HUGHES	HG5009
MR60	Germanium Diode	300520210	G.E.C.	GEX23
MR239	Germanium Diode	300520560	HUGHES	HG5009
MR240	Germanium Diode	300520560	HUGHES	HG5009

Printed Circuit Board No.7 (Circuit Diagram Sht.1)

Solartron Part No.555169.

RESISTORS Class Group No.5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type.	
R101	2700	10	¼	172332700	022-2058	Erie	16 Carbon
R102	5600	10	¼	17233560	022-2100	Erie	16 Carbon
R103	2700	10	¼	172332700	022-2058	Erie	16 Carbon
R104	11K	5	½	170541100		Painton	92 H.S.
R105	15K	5	½	170541500		Erie	92 H.S.
R106	43K	5	¼	170544300	021-9791	Erie	109 H.S.
R107	43K	5	½	170544300	021-0791	Erie	109 H.S.
R108	62K	10	¼	170446200	021-9814	Erie	109 H.S.
R109	220	10	¼	172322200	022-1151	Erie	16 Carbon
R110	22K	10	¼	172342200	022-2172	Erie	16 Carbon
R111	10M	10	¼	172371000		Erie	16 Carbon
R112	11K	1	½	170441100		Painton	92 H.S.
R113	12K	5	½	170541200		Painton	92 H.S.
R114	11K	1	½	170441100		Painton	92 H.S.
R115	27K	10	¼	172342700	022-2184	Erie	16 Carbon

RESISTORS(Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R116	8200	10		172342200	022-2121	Erie	16 Carbon
R117	22K	10		172332200	022-2046	Erie	16 Carbon
R118	2200	10		172332200	022-2046	Erie	16 Carbon
R119	47K	10		172344700	022-2214	Erie	16 Carbon
R120	10K	2		170441[illegible]		Painton	92 H.S.
R121	15K	5		170541500			
R122	1000	10		172331000	022-2004	Erie	16 Carbon
R123	10K	2		170441000		Painton	92 H.S.
R124	10K	10		172341000	022-2130	Erie	16 Carbon
R125	47K	10		172344700	022-2214	Erie	16 Carbon
R126	120	1		170421200		Painton	92 H.S..
R127	330	10		172323300	022-1172	Erie	16 Carbon
R128	47	1		170414700		Painton	72 H.S.
R129	200	1		170422000			
R130	750	1		170427500			

CAPACITORS Class Group No.5910. Country of Origin Code 99.

Cct. Ref.	Value µFd	Tol. %	Rating Volts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer& Type.	
C23	25	-20 +100	50	261072500		Hunts	ML 39T El.
C24	1	10	125	220361000		Wima	M Tropyfol MPo
C25	220pF	10	500	210522200	011-9208	Suflex	H.S. Po.
C80	220pF	10	500	210522200	011-9208		
C81	2200pF	20	400	N20553		Wima F	M.Po.
C82	470pF	10	500	210524700		Suflex	H.S. Po
C83	500	-20 +100	25	260785000		Hunts	MEF.37T El.

Printed Circuit Board No.7 (Circuit Diagram Sht.1) cont'd.

Valves Class Group No.5960 Country of Origin ode 99.

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type.	
V4	Double Triode	300033030	MULLARD	12AU7

SEMICONDUCTORS.

MR235	Germanium Diode	300520210	G.E.C.	GEX23
MR237	Germanium Diode	300520210	G.E.C.	GEX23
MR238	Germanium Diode	300520210	G.E.C.	GEX23
VT25	Transistor	300550300	MULLARD	OC200
VT26	Transistor	300550300	MULLARD	OC200
VT27	Transistor	300550290	MULLARD	OC170
VT28	Transistor	300550290	MULLARD	OC170
VT29	Transistor	300550080	G.E.C.	GET875
VT30	Transistor	300550290	MULLARD	OC170
VT31	Transistor	300550290	MULLARD	OC170

SEMICONDUCTORS (Cont'd)

Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type
MR116	Germanium Diode	300520210	G.E.C. GEX23
MR117	Germanium Diode	300520210	G.E.C. GEX23
MR118	Germanium Diode	300520210	G.E.C. GEX23
MR119	Germanium Diode	300520210	G.E.C. GEX23
MR120	Germanium Diode	300520210	G.E.C. GEX23
MR121	Germanium Diode	300520210	G.E.C. GEX23
MR122	Germanium Diode	300520210	G.E.C. GEX23
MR123	Germanium Diode	300520210	G.E.C. GEX23
MR124	Germanium Diode	300520210	G.E.C. GEX23
MR125	Germanium Diode	300520210	G.E.C. GEX23
MR126	Germanium Diode	300520210	G.E.C. GEX23
MR127	Germanium Diode	300520210	G.E.C. GEX23
MR128	Germanium Diode	300520210	G.E.C. GEX23
MR129	Germanium Diode	300520210	G.E.C. GEX23
MR130	Germanium Diode	300520210	G.E.C. GEX23
MR131	Germanium Diode	300520210	G.E.C. GEX23
MR132	Germanium Diode	300520210	G.E.C. GEX23
MR133	Germanium Diode	300520210	G.E.C. GEX23
MR134	Germanium Diode	300520210	G.E.C. GEX23
MR135	Germanium Diode	300520210	G.E.C. GEX23
MR136	Germanium Diode	300520210	G.E.C. GEX23
MR137	Germanium Diode	300520210	G.E.C. GEX23
MR179	Germanium Diode	300520210	G.E.C. GEX23
MR180	Germanium Diode	300520210	G.E.C. GEX23
MR181	Germanium Diode	300520210	G.E.C. GEX23
MR182	Germanium Diode	300520210	G.E.C. GEX23
VT140	Transistor	300550260	MULLARD OC83
VT141	Transistor	300550260	MULLARD OC83
VT142	Transistor	300550260	MULLARD OC83
VT143	Transistor	300550260	MULLARD OC83
VT144	Transistor	300550260	MULLARD OC83
VT145	Transistor	300550260	MULLARD OC83
VT146	Transistor	300550260	MULLARD OC83
VT147	Transistor	300550260	MULLARD OC83
VT148	Transistor	300550260	MULLARD OC83
VT149	Transistor	300550260	MULLARD OC83
VT150	Transistor	300550260	MULLARD OC83
VT151	Transistor	300550260	MULLARD OC83
VT152	Transistor	300550260	MULLARD OC83
VT153	Transistor	300550260	MULLARD OC83

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R259	1000	0.05	½	160700306≠		Alma WW
R264	1800	5	2.6	173431800		Welwyn AW3101
R276	14K	0.05	½	160700302≠		Alma WW
R308	25K	0.05	½	160700307≠		Alma WW
R312	50K	0.05	½	160700308≠		Alma WW
R316	100K	0.05	½	160700309≠		Alma WW
R321	200K	0.02	½	160700310≠		Alma WW
R322	220	5	¼	170522200	021-5480	Painton H.S.
R323	107.75K	0.05	½	160700311≠		Alma WW
R328	25K	0.02	¼	160300021		Alma WW
R334	50K	0.02	¼	160300022		Alma WW
R336	200M	20	½	160100026		Dubilier BTT Carbon
R337	100K	0.05	¼	160300024		Alma WW
R345	200K	0.1	¼	160300025		Alma WW
R350	250K	0.1	¼	160300026		Alma WW
R382	3.3M	10	¼	172363300	022-2226	Erie 16 Carbon
R383	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R384	6800	10	¼	172336800	022-2109	Erie 16 Carbon
R385	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R386	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R392	6800	10	¼	172336800	022-2109	Erie 16 Carbon
R364	47K	10	¼	172344700	022-2214	Erie 16 Carbon
R504	0.47	10	2.6	173500470		Solartron WW
R505	0.47	10	2.6	173500470		Solartron WW
R506	0.47	10	2.6	173500470		Solartron WW
R507	0.47	10	2.6	173500470		Solartron WW
R508	4700	10	¼	172334700	022-2088	

≠ See material schedule for matching information.

RESISTORS VARIABLE

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type
RV3	2500	10	½	110026080	Colvern CLR1206/9S WW
RV4	250	10	½	110026040	Colvern CLR1206/9S WW
RV5	25	10	½	110026010	Colvern CLR1206/9S WW
RV10	1000	10	2	110150060	Colvern CLR2401/9S WW
RV11	1000	10	2	110150060	Colvern CLR2401/9S W
RV12	250	10	½	110026040	Colvern CLR1206/9S WW
RV13	1500	10	½	110026070	Colvern CLR1206/9S WW
RV20	50	10	½	110026020	Colvern CLR1206/9S WW
RV21	100	10	½	110026030	Colvern CLR1206/9S WW
RV22	250	10	½	110026040	Colvern CLR1206/9S WW
RV23	500	10	½	110026050	Colvern CLR1206/9S WW
RV24	50K	20	¼	110007230	Colvern CLR1206/9S WW
RV30	2500	10	½		Colvern CLR1206/9S WW

MISCELLANEOUS

CAPACITOR

Cct. Ref.	Value µF	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
C6	0.1	5	125	208100002	Suflex	H.S.Po.
C11	0.47	10	400	220854700	Wima.M.	M.pl.
C12	0.01	20	1000	222851000	Hunts	M75 M.pl.

SEMICONDUCTORS.

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR12	Germanium Diode	300520250	G.E.C.	GEX541
MR13	Germanium Diode	300520250	G.E.C.	GEX541
MR14	Silicon Diode (Selected)	300520260	G.E.C.	SX51
MR15	Silicon Diode (Selected)	300520260	G.E.C.	SX51

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type	
RL1	Relay Sync.Chopper	300610010	A.E.I.	CK3
RL2	Relay Sync.Chopper	300610010	A.E.I.	CK3
S1	Switch Toggle DP.6A.	376000070	Painton	
S2	Switch Toggle DP.6A	376000070	Painton	
S3	Switch Toggle DP.6A	376000070	Painton	
S4	Switch Wafer	370100040		
S5	Switch Wafer	370100010		
S6	Switch Lever	375000020		
S7	Switch Wafer	371204070		
S8	Switch Push Button	378000030		
T1	Transformer	301060010		
MSP	Mains Selector Panel	39900050		
FS1	Fuse 2-5A	360101330	Belling & Lee L562.	

SEMICONDUCTORS (Cont'd)

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type.	
VT32	Transistor	300550360	S.T.C.	TK40C
VT33	Transistor	300550420	R.C.A.(C.B)	2N269
VT34	Transistor	300550030	G.E.C.	GET102
VT35	Transistor	300550030	G.E.C.	GET102

Printed Circuit Board No.8 (Circuit Diagram Sht.3)
Solartron Part No. 555168/3

RESISTORS Class Group No.5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms.	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type.	
R414	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R415	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R416	220K	10	¼	172352200	022-3079	Erie	16 Carbon.
R417	82K	10	¼	172348200	022-3028	Erie	16 Carbon.
R418	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R419	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R420	220K	10	¼	172352200	022-3079	Erie	16 Carbon.
R421	82K	10	¼	172348200	022-3028	Erie	16 Carbon.
R422	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R423	220K	10	¼	172352200	022-3079	Erie	16 Carbon.
R424	82K	10	¼	172348200	022-3028	Erie	16 Carbon.
R425	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R426	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R427	82K	10	¼	172348200	022-3028	Erie	16 Carbon.
R428	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R429	82K	10	¼	172348200	022-3028	Erie	16 Carbon.
R430	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R431	82K	10	¼	172348200	022-3028	Erie	16 Carbon.
R432	27K	10	¼	172342700	022-2184	Erie	16 Carbon.
R433	82K	10	¼	172348200	022-3028	Erie	16 Carbon.

SEMICONDUCTORS.

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type.	
MR106	Germanium Diode	300520210	G.E.C.	GEX23
MR107	Germanium Diode	300520210	G.E.C.	GEX23
MR108	Germanium Diode	300520210	G.E.C.	GEX23
MR109	Germanium Diode	300520210	G.E.C.	GEX23
MR110	Germanium Diode	300520210	G.E.C.	GEX23
MR111	Germanium Diode	300520210	G.E.C.	GEX23
MR112	Germanium Diode	300520210	G.E.C.	GEX23
MR113	Germanium Diode	300520210	G.E.C.	GEX23
MR114	Germanium Diode	300520210	G.E.C.	GEX23
MR115	Germanium Diode	300520210	G.E.C.	GEX23

Printed Circuit Board No.9 (Circuit Diagram Sht.3)

Solartron Part No. 555167/3

Cct. Ref.	Value Ohms.	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R434	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R437	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R438	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R439	82K	10	¼	172348200	022-3028	Erie 16 Carbon
R440	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R441	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R442	82K	10	¼	172348200	022-3028	Erie 16 Carbon
R443	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R444	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R445	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R446	82K	10	¼	172348200	022-3028	Erie 16 Carbon
R447	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R448	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R449	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R450	82K	10	¼	172348200	022-3028	Erie 16 Carbon
R451	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R452	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R453	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R455	82K	10	¼	172348200	022-3028	Erie 16 Carbon
R456	27K	10	¼	172342700	022-2184	Erie 16 Carbon

SEMICONDUCTORS.

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type
MR139	Germanium Diode	300520210	G.E.C. GEX23
MR140	Germanium Diode	300520210	G.E.C. GEX23
MR141	Germanium Diode	300520210	G.E.C. GEX23
MR142	Germanium Diode	300520210	G.E.C. GEX23
MR143	Germanium Diode	300520210	G.E.C. GEX23
MR144	Germanium Diode	300520210	G.E.C. GEX23
MR145	Germanium Diode	300520210	G.E.C. GEX23
MR146	Germanium Diode	300520210	G.E.C. GEX23
MR147	Germanium Diode	300520210	G.E.C. GEX23
MR148	Germanium Diode	300520210	G.E.C. GEX23
MR149	Germanium Diode	300520210	G.E.C. GEX23
MR150	Germanium Diode	300520210	G.E.C. GEX23
MR151	Germanium Diode	300520210	G.E.C. GEX23
MR152	Germanium Diode	300520210	G.E.C. GEX23
MR153	Germanium Diode	300520210	G.E.C. GEX23

SEMICONDUCTORS (Cont'd)

Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type.	
MR154	Germanium Diode	300520210	G.E.C.	GEX23
MR155	Germanium Diode	300520210	G.E.C.	GEX23
MR156	Germanium Diode	300520210	G.E.C.	GEX23
MR157	Germanium Diode	300520210	G.E.C.	GEX23
MR158	Germanium Diode	300520210	G.E.C.	GEX23
MR159	Germanium Diode	300520210	G.E.C.	GEX23
MR160	Germanium Diode	300520210	G.E.C.	GEX23
MR161	Germanium Diode	300520210	G.E.C.	GEX23
MR162	Germanium Diode	300520210	G.E.C.	GEX23
MR163	Germanium Diode	300520210	G.E.C.	GEX23
MR164	Germanium Diode	300520210	G.E.C.	GEX23
MR165	Germanium Diode	300520210	G.E.C.	GEX23
MR166	Germanium Diode	300520210	G.E.C.	GEX23
MR167	Germanium Diode	300520210	G.E.C.	GEX23
MR168	Germanium Diode	300520210	G.E.C.	GEX23
MR169	Germanium Diode	300520210	G.E.C.	GEX23
MR170	Germanium Diode	300520210	G.E.C.	GEX23
MR171	Germanium Diode	300520210	G.E.C.	GEX23
MR172	Germanium Diode	300520210	G.E.C.	GEX23
MR173	Germanium Diode	300520210	G.E.C.	GEX23
MR174	Germanium Diode	300520210	G.E.C.	GEX23
MR175	Germanium Diode	300520210	G.E.C.	GEX23
MR176	Germanium Diode	300520210	G.E.C.	GEX23
MR177	Germanium Diode	300520210	G.E.C.	GEX23
MR178	Germanium Diode	300520210	G.E.C.	GEX23
MR184	Germanium Diode	300520210	G.E.C.	GEX23
MR185	Germanium Diode	300520210	G.E.C.	GEX23
MR186	Germanium Diode	300520210	G.E.C.	GEX23
MR187	Germanium Diode	300520210	G.E.C.	GEX23
MR188	Germanium Diode	300520210	G.E.C.	GEX23
MR189	Germanium Diode	300520210	G.E.C.	GEX23
MR190	Germanium Diode	300520210	G.E.C.	GEX23
MR191	Germanium Diode	300520210	G.E.C.	GEX23
MR192	Germanium Diode	300520210	G.E.C.	GEX23
MR193	Germanium Diode	300520210	G.E.C.	GEX23
VT158	Transistor	300550260	MULLARD	OC83
VT159	Transistor	300550260	MULLARD	OC83
VT160	Transistor	300550260	MULLARD	OC83
VT161	Transistor	300550260	MULLARD	OC83
VT162	Transistor	300550260	MULLARD	OC83
VT163	Transistor	300550260	MULLARD	OC83
VT164	Transistor	300550260	MULLARD	OC83
VT165	Transistor	300550260	MULLARD	OC83
VT166	Transistor	300550260	MULLARD	OC83
VT167	Transistor	300550260	MULLARD	OC83

Printed Circuit Board No. 10 (Circuit Diagram Sht.2)

Solartron Part No. 5551

RESISTORS Class Group No. 5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R140	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R141	1800	10	¼	172331800	022-2037	Erie 16 Carbon
R142	220K	10	¼	172322200	022-3079	Erie 16 Carbon
R143	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R144	1800	5	2.6	173431800		Welwyn AW3101 W.W.
R145	27K	10	½	172342700	022-2184	Erie 16 Carbon
R146	1500	10	¼	172331500	022-2025	Erie 16 Carbon
R147	2700	10	¼	172332700	022-2058	Painton 72 H.S.
R148	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R150	100K	10	¼	17235100	022-3037	Erie 16 Carbon
R151	22K	5	½	170542200		Painton 92 H.S.
R152	1800	5	2.6	173431800		Welwyn AW 3101 W.W.
R153	1800	10	½	173231800	022-2037	Erie 16 Carbon
R154	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R155	1500	10	¼	172331500	022-2025	Erie 16 Carbon
R156	2700	10	¼	172332700	022-2058	Painton 72 H.S.
R157	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R158	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R159	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R160	1800	5	2.6	173431800		Welwyn AW 3101 W.W.
R161	100K	10	¼	17235100	022-3037	Erie 16 Carbon
R162	22K	5	¼	170542200		Painton 92 H.S.
R163	1800	5	2.6	173431800		Welwyn AW 3101 W.W.
R164	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R165	1800	10	¼	172318[illegible]	022-2037	Erie 16 Carbon
R166	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R167	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R168	1800	5	2.6	173431800		Welwyn AW 3101 W.W.
R169	2700	10	¼	172332700	022-2058	Erie 16 Carbon
R170	10K	10	¼	172340000	022-2130	Erie 16 Carbon
R171	1500	10	¼	172331500	022-2025	Erie 16 Carbon
R172	100K	10	¼	172351000	022-3037	Erie 16 Carbon
R173	22K	5	¼	170542200		Painton 92 H.S.
R174	1800	5	2.6	173431800		Welwyn S[illegible] 3112
R175	1500	10	¼	172331500	022-2025	
R176	1800	10	¼	172331800	022-2037	Erie 16 Carbon
R177	2700	10	½	172332700	022-2058	Erie 16 Carbon
R178	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R179	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R180	22K	10	¼	172342200	022-2172	Erie 16 Carbon

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R181	1800	5	2.6	173431800		Welwyn AW 3112 W.W.
R182	100K	10	¼	172351000	022-3037	Erie 16 Carbon
R183	22K	5	¼	170542200	022-3037	Painton 92 H.S.
R184	1800	5	2.6	173431800		Welwyn AW 3112 W.W.

CAPACITORS

Cct. Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No.	Manufacturer & Type
C26	0.02	10	250	208350011	Hunts W97 BM14A M.P.
C27	0.0047	10	125	221334800	WIMA.M M.Po.
C28	470pF	-20 +80	500		Hunts Hi-k CD7K/2 Ce.
C29	0.02	10	250	208350011	Hunts W97 BM14A M.P.
C30	470pF	-20 +80	500	241024700	Hunts Hi-k CD7K/2 Ce.
C31	0.02	10	250	208350011	Hunts BM14A M.Po.
C32	0.0047	10	125	221334700	WIMA.M M.Po.
C33	470pF	-20 +80	500	241024700	Hunts Hi-k CD7K Ce.
C34	0.02	10	250	208350011	Hunts W97 BM14A M.P.
C35	0.0047	10	125	221334700	WIMA.M
C36	470pF	-20 +80	500	241024700	Hunts Hi-k CD7K/2 Ce.
C37	0.0047	10	125	221334700	WIMA.M M.Po.

SEMICONDUCTORS.

Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type
MR22	Germanium Diode	300520210	G.E.C. GEX23.
MR23	Germanium Diode	300520210	G.E.C. GEX23.
MR24	Germanium Diode	300520560	Hughes HG 5009.
MR25	Germanium Diode	300520210	G.E.C. GEX23.
MR26	Germanium Diode	300520210	G.E.C. GEX23.
MR27	Germanium Diode	300520560	Hughes HG 5009.
MR28	Germanium Diode	300520210	G.E.C. GEX23.
MR29	Germanium Diode	300520210	G.E.C. GEX23.
MR30	Germanium Diode	300520560	Hughes HG 5009.
MR31	Germanium Diode	300520210	G.E.C. GEX23.
MR32	Germanium Diode	300520560	Hughes HG 5009.
MR33	Germanium Diode	300520210	G.E.C. GEX23.
VT40	Transistor	300550240	Mullard OC75.
VT41	Transistro	300550360	S.T.C. TK40C.

SEMICONDUCTORS (Cont'd)

Cct. Ref.	Description	Solartron	Manufacturer & Type
VT42	Transistor	300550240	Mullard OC75.
VT43	Transistor	300550360	S.T.C. TK40C.
VT44	Transistor	300550240	Mullard OC75.
VT45	Transistor	300550360	S.T.C. TK40C.
VT46	Transistor	300550360	S.T.C. TK40C.
VT47	Transistor	300550360	S.T.C. TK40C.
VT48	Transistor	300550240	Mullard OC75.
VT49	Transistor	300550360	S.T.C. TK40C.
VT50	Transistor	300550360	S.T.C. TK40C.
VT51	Transistor	300550360	S.T.C. TK40C.

Printed Circuit Board No.11 (Circuit Diagram Sht.2)

Solartron Part No. 555196

RESISTORS Class Group No.,5905 Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R247	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R248	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R250	68K	10	¼	172346800	022-3016	Erie 16 Carbon
R251	1500	10	¼	172331500	022-2025	Erie 16 Carbon
R252	1800	10	¼	173331800	022-2037	Erie 16 Carbon
R253	220K	10	¼	172352200	022-3079	Erie 16 Carbon
R254	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R260	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R261	2700	10	¼	172332700	022-2058	Painton 72 H.S.
R262	100K	10	¼	172351000	022-3037	Erie 16 Carbon
R263	22K	5	¼	170542200	021-6291	Painton 92 H.S.
R265	15K	1	¼	170441500	021-6251	Painton 92 H.S.
R266	68K	10	¼	172346800	022-3016	Erie 16 Carbon
R267	3900	1	¼	170433900	021-5780	Painton 92 H.S.
R268	1800	10	¼	172331800	022-2037	Erie 16 Carbon
R269	68K	10	¼	172346800	022-3016	Erie 16 Carbon
R270	68K	10	¼	172346800	022-3016	Erie 16 Carbon
R271	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R272	3900	10	¼	172333900	022-2079	Erie 16 Carbon
R273	3900	10	¼	172333900	022-2079	Erie 16 Carbon
R274	2200	5	2.6	173432200		Welwyn AW 3101 W.W.
R275	1500	10	¼	172331500	022-2025	Erie 16 Carbon
R309	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R310	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R311	10	10	¼	172341000	022-2130	Erie 16 Carbon
R313	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R314	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R315	22K	10	¼	172342200	022-2172	Erie 16 Carbon
R317	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R318	3300	10	¼	172333300	022-2067	Erie 16 Carbon

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Ratin Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R319	3300	10	¼	172333300	022-2067	Erie	16 Carbon
R320	390K	10	¼	172353900	022-3112	Erie	16 Carbon
R324	5600	10	¼	172335600	022-2100	Erie	16 Carbon
R325	82K	10	¼	172348200	022-3028	Erie	16 Carbon
R326	82K	10	¼	172348200	022-3028	Erie	16 Carbon
R327	5600	10	¼	172335600	022-2100	Erie	16 Carbon
R329	390K	10	¼	172353900	022-3112	Erie	16 Carbon
R330	56K	10	¼	172345600	022-3007	Erie	16 Carbon
R331	27K	10	¼	172342700	022-2184	Erie	16 Carbon
R335	33K	10	¼	172343300	022-2193	Erie	16 Carbon
R388	180K	10	¼	172351800	022-3070	Erie	16 Carbon
R389	180K	10	¼	172351800	022-3070	Erie	16 Carbon
R396	100K	10	¼	172351000	022-3037	Erie	16 Carbon
R397	68K	10	¼	172346800	022-3016	Erie	16 Carbon
R398	18K	10	¼	172341800	022-2163	Erie	16 Carbon
R402	270K	10	¼	172352700	022-3091	Erie	16 Carbon
R403	62K	1	¼	170446200		Painton	92 H.S.
R404	4700	1	¼	170434700		Painton	92 H.S.
R412	47K	10	¼	172344700	022-2214	Erie	16 Carbon
R413	180K	10	¼	172351800	022-3070	Erie	16 Carbon
R435	4700	10	¼	172334700	022-2088	Erie	16 Carbon

CAPACITORS Class Group No.5910. Country of Origin Code 99.

Cct. Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No	Inter-Service Ref.No.	Manufacturer & Type	
C61	0.02	10	250	208350011		Hunts W97	MP.
C62	0.0047	10	125	221334700		Wima F	M.Po.
C63	470pF	-20	500	241024700		Hunts Ki-k	CD 7K/2 Ce
C64	1000pF	10	400	22331000		Wima M	M.Po
C65	0.022	20	125	220442200		Wima M	M.Po
C66	2200pF	10	400	222331000		Wima F	M.Po
C67	0.01	20	125	220441000		Wima M	M.Po
C68	2200pF	10	400	222432200		Wima F	M.Po
C69	220pF	10	125	21022200		G.E.C.	Po.
C70	220pF	10	125	210222200		G.E.C.	Po.

SEMICONDUCTORS

Cct. Ref.	Description	Solartron	Manufacturer & Type	
MR80	Germanium Diode	300520210	G.E.C.	GEX23
MR81	Germanium Diode	300520560	Hughes	HG5009
MR82	Germanium Diode	300520210	G.E.C.	GEX23
MR84	Germanium Diode	300520210	G.E.C.	GEX23
MR85	Germanium Diode	300520210	G.E.C.	GEX23

SEMICONDUCTORS (Cont'd)

Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR86	Germanium Diode	300520210	G.E.C.	GEX23
MR87	Germanium Diode	300520210	G.E.C.	GEX23
MR88	Germanium Diode	300520210	G.E.C.	GEX23
MR89	Germanium Diode	300520210	G.E.C.	GEX23
MR90	Germanium Diode	300520210	G.E.C.	GEX23
MR91	Germanium Diode	300520210	G.E.C.	GEX23
MR100	Germanium Diode	300520210	G.E.C.	GEX23
MR101	Germanium Diode	300520210	G.E.C.	GEX23
VT90	Transistor	300550240	Mullard	OC75
VT91	Transistor	300550360	S.T.C.	TK40C
VT92	Transistor	300550360	S.T.C.	TK40C
VT93	Transistor	300550030	G.E.C.	GET102
VT94	Transistor	300550240	Mullard	OC75
VT95	Transistor	300550360	S.T.C.	TK40C
VT96	Transistor	300550030	G.E.C.	GET102
VT97	Transistor	300550360	S.T.C.	TK40C
VT98	Transistor	300550080	Mullard	OC139
VT99	Transistor	300550360	S.T.C.	TK40C
VT103	Transistor	300550360	S.T.C.	TK40C
VT104	Transistor	300550360	S.T.C.	TK40C
VT105	Transistor	300550360	S.T.C.	TK40C
VT107	Transistor	300550360	S.T.C.	TK40C
VT127	Transistor	300550360	S.T.C.	TK40C
VT129	Transistor	300550360	S.T.C.	TK40C
VT133	Transistor	300550030	G.E.C.	GET102

Printed Circuit Board No.12 (Circuit Diagram Sht.2)
Solartron Part No. 555197

RESISTORS Class Group No.5905 Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R249	1500	10	¼	172331500	022-2025	Erie	16 Carbon
R339	12K	10	¼	172341200	022-2142	Erie	16 Carbon
R340	2700	1	¼	170432700	021-5740	Painton	92 H.S.
R341	470K	10	¼	172354700	022-3121	Erie	16 Carbon
R342	5600	10	¼	172335600	022-2100	Erie	16 Carbon
R346	18K	1	¼	170441800	021-	Painton	72 H.S.
R347	8200	10	¼	172338200	022-2121	Erie	16 Carbon
R348	1000	10	¼	172331000	022-2004	Erie	16 Carbon
R349	68K	10	¼	172346800	022-3016	Erie	16 Carbon
R351	150K	10	¼	172351500	022-3058	Erie	16 Carbon
R352	47K	10	¼	172344700	022-2214	Erie	16 Carbon
R353	3900	10	¼	172333900	022-2079	Erie	16 Carbon
R354	20K	1	¼	170442000		Painton	92 H.S.
R355	47K	10	¼	172344700	022-2214	Erie	16 Carbon
R356	56K	10	¼	172345600	022-3007	Erie	16 Carbon

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R357	3900	10	¼	172333400	022-2079	Erie	16 Carbon
R359	150K	10	¼	172351500	022-3058	Erie	16 Carbon
R360	47K	10	¼	172344700	022-2214	Erie	16 Carbon
R362	10K	10	¼	172341000	022-2130	Erie	16 Carbon
R363	47K	10	¼	172344700	022-2214	Erie	16 Carbon
R366	82K	10	¼	172348200	022-3028	Erie	16 Carbon
R367	47K	10	¼	172344700	022-2214	Erie	16 Carbon
R368	18K	10	¼	172341800	022-2103	Erie	16 Carbon
R369	4700	10	¼	172334700	022-2088	Erie	16 Carbon
R370	270K	10	¼	172352700	022-3091	Erie	16 Carbon
R371	220	10	¼	172322200	022-1151	Erie	16 Carbon
R372	56K	10	¼	172345600	022-3007	Erie	16 Carbon
R373	27K	10	¼	172342700	022-2184	Erie	16 Carbon
R374	100K	10	¼	172351000	022-3037	Erie	16 Carbon
R378	100K	10	½	172351000	022-3037	Erie	16 Carbon
R387	4700	10	¼	172334700	022-2088	Erie	16 Carbon
R390	680	1	¼	170426800		Painton	92 H.S.
R391	22K	10	¼	172342200	022-2172	Erie	16 Carbon
R392	33K	10	¼	172343300	022-2193	Erie	16 Carbon
R393	1800	10	¼	172331800	022-2037	Erie	16 Carbon
R394	33K	10	¼	172343300	022-2193	Erie	16 Carbon
R395	3900	10	¼	172333900	022-2079	Erie	16 Carbon
R399	15K	10	¼	172341500	022-2151	Erie	16 Carbon
R401	4700	10	¼	172334700	022-2088	Erie	16 Carbon
R405	12K	1	¼	170441200		Painton	92 H.S.
R406	3.9K		¼	172333900		Erie	16 Carbon
R407	100K	10	¼	172351000	022-3037	Erie	16 Carbon
R409	3000	1	¼	170433000		Painton	72 H.S.
R410	27K	10	¼	172342700	022-2184	Erie	16 Carbon
R411	100K	10	¼	172351000	022-3037	Erie	16 Carbon

CAPACITORS

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
C60	0.02	10	250	208350011		Hunts	W97 M.P
C71	1	10	125	220361000		Wima M	M.Po
C72	0.047	10	125	220344700		Wima M	M.Po
C73	0.01	20	125	220441000		Wima M	M.Po
C74	0.01	20	125	220441000		Wima M	M.Po
C75	1000pF	20	500	241031000		Hunts Mi-k CD 7K/2 Oe.	
C76	0.022	20	125	220442200		Wima M	M.Po
C77	0.022	2	125	210142200		Suflex	H.S.Po
C78	1000pF	10	400	222331000		Wima M	M.Po

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R11	100	10	¼	172321000	022-1109	Erie 16 Carbon
R12	33	10	¼	172313300	022-1046	Erie 16 Carbon
R13	33	10	¼	172313300	022-1046	Erie 16 Carbon
R14	100	10	¼	172321000	022-1109	Erie 16 Carbon

CAPACITORS

Cct. Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No.	Manufactuer & Type
C1	25	-20 +100	50	261072500	Hunts MEW39T El.
C2	25	-20 +100	50	261072500	Hunts MEW39T El.
C3	30	-20 +100	20	260775000	Hunts MEW31T El.

VALVES

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type
V1	Pentode	300005300	Mullard ME1400
	Pentode	300005300	Mullard ME1400
V3	Double Triode	300033120	Mullard ECC88

Printed Circuit Board No.21 (Circuit Diagram Sht.2)
Solartron Part No. 555201

RESISTORS.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type
R358	500K	0.5	½	160000021	Electronic AP½J
R361	1M	0.5	½	160000023	Electronic AP½J
R375	2.5M	1	½	160000025	Electronic AP½J
R379	5M	1	½	160000026	Electronic AP½J
R380	10M	2	½	160000024	Electronic AP½J
R381	20M	5	½	160000028	Electronic AP½J
R502	2M	1	½	160000024	Electronic AP½J

POWER CHASSIS

RESISTORS. Class Group No.5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufactuer & Type
R47	1M	≠	½	160700204		Alma Prec.W.W.
R48	8M	≠	2	160700205		Alma Prec.W.W.
R49	10K	1	¼	170441000		Painton 72 H.S.
R50	900K	≠	½	160700203		Alma Prec.W.W.
R51	90K	≠	½	160700202		Alma Prec.W.W.
R52	10K	≠	½	160700201		Alma Prec.W.W.
R53	390	1	0.7	196423900		Welwyn Electrosil N25 OF
R54	270	1	¼	170422700		Painton 72 H.S.

≠ Value ± 0.05% Ratios to ± 0.01%
Temperature Coefficient matched to 5 parts in a million

Note: Resistors R47-R48 and R50-R52 are a matched set.

CAPACITORS

Cct. Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No.	Manufacturer & Type
C14	1000	-20 +50	100	280600017	Plessey CE4072/12 El.
C15	5000	-20 +50	12	260495000	Hunts MEF107T El.
C16	5000	-20 +50	25	260895000	Hunts KB.63AT El.
C18	2500	-20 +50	50	261592500	Hunts KB.112AT El.
C20	500	-20 +50	50	261085000	Hunts MEF47T El.
C22	500	-20 +100	25	260785000	Hunts MEF37T El.

SEMICONDUCTORS

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type
MR4	Silicon Diode	300520290	G.E.C. SX632
MR5	Silicon Diode	300520290	G.E.C. SX632
MR6	Silicon Diode	300520280	G.E.C. SX631
MR7	Silicon Diode	300520250	G.E.C. SX631
MR8	Germanium Diode	300520250	G.E.C. GEX541
MR9	Germanium Doode	300520250	G.E.C. GEX541
MR19	Silicon Diode	300520130	OAZ203
VT9	Transistor	300550170	Mullard OC35
VT12	Transistor	300550170	Mullard OC35
VT24	Transistor	300550170	Mullard OC35

MISCELLANEOUS

RESISTORS. Class Group No. 5905. Country of Origin Code 99.

Cct.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R17	100	10	¼	172321000	022-1109	Erie 16 Carbon
R18	100	10	¼	172321000	022-1109	Erie 16 Carbon
R19	330	10	¼	172323300	022-1172	Erie 16 Carbon
R46	120K	5	¼	170551200		
R68	1800	5	2.6	173431800		Welwyn AW 3101
R86	220	5	2.6	173422200		Welwyn AW 3101
R90	330	5	2.6	173423300		Welwyn AW 3101
R91	8500 ≠	0.1	½	160700101		Alma WW
R92	330	5	2.6	173423300		Welwyn AW 3101
R93	8500 ≠	0.1	½	160700101		Alma WW
R100	10K≠	0.1	½	160700102		Alma WW
R255	1800	5	2.6	173431800		Welwyn AW 3101
R256	4600	5	½	160700303 ♯		Alma WW
R257	1300	5	½	160700304 ♯		Alma WW
R258	3100	5	½	160700305 ♯		Alma WW

♯ See material schedule for matching information.
≠ Temp.Coeff.matched to 5 parts in a million.

Printed Circuit Board No.12 (Cont'd)

SEMICONDUCTORS.

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type
VT108	Transistor	300550360	S.T.C. TK40C
VT109	Transistor	300550360	S.T.C. TK40C
VT110	Transistor	300550360	S.T.C. TK40C
VT115	Transistor	300550240	Mullard OC75
VT116	Transistor	300550240	Mullard OC75
VT117	Transistor	300550360	S.T.C. TK40C
VT118	Transistor	300550240	Mullard OC75
VT119	Transistor	300550030	G.E.C. GET102
VT120	Transistor	300550030	G.E.C. GET102
VT121	Transistor	300550170	G.E.C. GET102
VT122	Transistor	300550170	Mullard OC35
VT125	Transistor	300550240	Mullard OC75
VT126	Transistor	300550240	Mullard OC75
VT128	Transistor	300550240	Mullard OC75
VT130	Transistor	300550240	Mullard OC75
VT131	Transistor	300550240	Mullard OC75
VT132	Transistor	300550360	S.T.C. TK40C
VT134	Transistor	300550280	Mullard OC139
MR93	Germanium Diode	300520210	G.E.C. GEX23
MR94	Germanium Diode	300520210	G.E.C. GEX23
MR95	Germanium Diode	300520210	G.E.C. GEX23
MR96	Germanium Diode	300520210	G.E.C. GEX23
MR97	Germanium Diode	300520210	G.E.C. GEX23
MR98	Germanium Diode	300520210	G.E.C. GEX23
MR99	Germanium Diode	300520210	G.E.C. GEX23
MR230	Germanium Diode	300520210	G.E.C. GEX23

Printed Circuit Board No.13 (Circuit Diagram Sht's 1 & 2)

Solartron Part No. 555194.

RESISTORS Class Group No. 5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R55	330	10	¼	172323300	022-1172	Erie 16 Carbon
R56	1800	10	¼	172331800	022-2037	Erie 16 Carbon
R57	220	10	¼	172322200	022-1151	Erie 16 Carbon
R58	6.8K	5	¼	170536800		Painton 92 H.S.
R59	750	5	¼	170527500		Painton 92 H.S.
R60	10K	10	¼	172341000	022-2130	Erie 16 Carbon
R61	1200	5	2.6	173431200		Welwyn AW 3101 W.W.
R62	1200	5	2.6	173431200		Welwyn AW 3101 W.W.
R63	18K	5	¼	170541800		Painton 92 H.S.
R64	2700	5	¼	170532700		Painton 92 H.S.

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R65	1000	5	¼	170531000	021-9557	Painton 92 H.S.
R66	1000	5	¼	170531000		Painton 92 H.S.
R67	2700	5	½	170832700		Painton H.S.
R88	3300	1	¼	170433300		Painton 92 H.S.
R89	3300	1	¼	170433300		Painton 92 H.S.
R95	4700	10	¼	172334700	022-2088	Erie 16 Carbon
R97	100	10	¼	172321000	022-1109	Erie 16 Carbon
R332	56K	10	¼	172345600	022-3007	Erie 16 Carbon
R333	27K	10	¼	172342700	022-2184	Erie 16 Carbon
R500	150K	10	¼	172351500	022-3058	Erie 16 Carbon
R501	22K	10	¼	172342200	022-2172	Erie 16 Carbon
REISTORS VARIABLE						
RV8	500	10	1	110151020		Painton 316510 WW
RV9	500	10	1	110151020		Painton 316510 WW
CAPACITORS						
C21	500	-20 +100	25	260785000		Hunts MEF37 T El.

SEMICONDUCTORS

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type
MR10	Silicon Diode	300520280	G.E.C. SX631
MR11	Silicon Diode	300520280	G.E.C. SX631
MR18	Silicon Diode(selected	300520260	G.E.C. SX5L1
MR92	Germanium Diode	300520210	G.E.C. GEX23
VT8	Transistor	300550030	G.E.C. GET102
VT10	Transistor	300550030	G.E.C. GET102
VT13	Transistor		Brush OC700
VT14	Transistor	300550240	Mullard OC75
VT15	Transistor		Brush OC700
VT16	Transistor		Brush OC700
VT17	Transistor		Brush OC700
VT23	Transistor	300550280	Mullard OC139
VT106	Transistor	300550360	S.T.C. TK40C
VT200	Transistor	300550240	Mullard OC75

Printed Circuit Boards Nos. 14 & 15 (Circuit Diagram Sht.3)
Solartron Part No. 555170/3A

Note: Component references are identical for both boards, therefore, components for one board only have been listed.

RESISTORS Class Group No. 5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R245	27K	5	¼	170542700		Painton	72 H.S.
R294	33K	5	¼	170543300		Painton	72 H.S.
R296	33K	5	¼	170543300		Painton	72 H.S.
R297	33K	5	¼	170543300		Painton	72 H.S.
R298	27K	5	¼	170542700		Painton	72 H.S.
R299	33K	5	¼	170543300		Painton	72 H.S.
R300	33K	5	¼	170543300		Painton	72 H.S.
R301	27K	5	¼	170542700		Painton	72 H.S.
R302	33K	5	¼	170543300		Painton	72 H.S.
R303	33K	5	¼	170543300		Painton	72 H.S.
R304	27K	5	¼	170542700		Painton	72 H.S.
R305	33K	5	¼	170543300		Painton	72 H.S.
R365	100	10	¼	172321000		Erie	16 Carbon
R436	4700	10	¼	172334700		Erie	16 Carbon

SEMICONDUCTORS

Cct.Ref.	Description	Solartron Part No.	Manufacture & Type	
MR70	Germanium Diode	300520210	G.E.C.	GEX23
MR71	Germanium Diode	300520210	G.E.C.	GEX23
MR72	Germanium Diode	300520210	G.E.C.	GEX23
MR73	Germanium Diode	300520210	G.E.C.	GEX23
VT80	Transistor	300550360	S.T.C.	TK40C
VT81	Transistor	300550360	S.T.C.	TK40C
VT82	Transistor	300550360	S.T.C.	TK40C
VT83	Transistor	300550360	S.T.C.	TK40C
VT84	Transistor	300550360	S.T.C.	TK40C
VT85	Transistor	300550360	S.T.C.	TK40C
VT86	Transistor	300550360	S.T.C.	TK 0C
VT87	Transistor	300550360	S.T.C.	TK40C
CT84	Cap.Met.Polyester	221351000	Wima.M.	
CT85	Cap.Met.Poly			

Printed Circuit Board Nos. 16 & 17 (Circuit Diagram Sht.2)

Solartron Part No. 555170/3

RESISTORS Class Group No. 5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R278	8200	5	¼	170538200		Painton	92 H.S.
R279	10K	5	¼	170541000		Painton	92 H.S.
R280	10K	5	¼	170541000		Painton	92 H.S.
R281	8200	5	¼	170538200		Painton	92 H.S.
R282	10K	5	¼	170541000		Painton	92 H.S.
R283	10K	5	¼	170541000		Painton	92 H.S.
R284	8200	5	¼	170538200		Painton	92 H.S.
R285	10K	5	¼	170541000		Painton	92 H.S.
R286	10K	5	¼	170541000		Painton	92 H.S.
R287	33K	5	¼	170543300		Painton	92 H.S.
R288	27K	5	¼	170542700		Painton	92 H.S.
R289	33K	5	¼	170543300		Painton	92 H.S.

SEMICONDUCTORS

Cct.Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR62	Germanium Diode	300520210	G.E.C.	GEX23
MR63	Germanium Diode	300520210	G.E.C.	GEX23
MR64	Germanium Diode	300520210	G.E.C.	GEX23
MR65	Germanium Diode	300520210	G.E.C.	GEX23
VT70	Transistor	300550360	S.T.C.	TK40C
VT71	Transistor	300550360	S.T.C.	TK40C
VT72	Transistor	300550360	S.T.C.	TK40C
VT73	Transistor	300550360	S.T.C.	TK40C
VT74	Transistor	300550360	S.T.C.	TK40C
VT75	Transistor	300550360	S.T.C.	TK40C
VT76	Transistor	300550360	S.T.C.	TK40C
VT77	Transistor	300550360	S.T.C.	TK40C

Printed Circuit Board No. 18 (Circuit Diagram Sht.1)

Solartron Part No. 555195

RESISTORS Class Group No. 5905. Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R69	12K	10	¼	172341200	022-2142	Erie	16 Carbon
R70	220	5	2.6	173422200		Welwyn	AW 3101
R75	220	5	2.6	173422200		Welwyn	AW 3101
R76	27K	10	¼	172342700	022-2184	Erie	16 Carbon
R77	220	5	2.6	173422200		Welwyn	AW 3101

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R78	27K	10	¼	17234700	022-2184	Erie 16 Carbon
R79	220	5	2.6	173422200		Welwyn AW 3101
R80	220	5	2.6	173422200		Welwyn AW 3101
R81	220	5	2.6	173422200		Welwyn AW 3101
R82	3900	10	¼	172333900	022-2079	Erie 16 Carbon
R84	3900	1	¼	170433900		Painton 92 H.S.
R85	3900	1	¼	170433900		Painton 92 H.S.

SEMICONDUCTORS

Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type
MR16	Germanium Diode	300520560	Hughes HG5009
MR17	Germanium Diode	300520560	Hughes HG5009
VT18	Transistor	300550360	S.T.C. TK40C
VT19	Transistor	300550360	S.T.C. TK40C
VT20	Transistor	300550360	S.T.C. TK40C
VT21	Transistor	300550360	S.T.C. TK40C

Printed Circuit Board No.19 (Circuit Diagram Sht.1)

Solartron Part No. 555200.

RESISTORS Class Group No. 5905 Country of Origin Code 99.

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type
R20	18K	5	¼	170541800		Painton 92 H.S.
R21	150K	5	¼	170551500		Painton 92 H.S.
R22	18K	5	¼	170551500		Painton 92 H.S.
R23	1000	5	¼	170531000		Erie 109 H.S.
R24	82K	5	¼	170548200		Erie 109 H.S.
R25	11K	1	¼	170441100		Painton 92 H.S.
R26	27	10	¼	172312700		Erie 16 Carbon
R27	15K	1	¼	170441500		Painton 92 H.S.
R28	27	10	¼	172312700		Erie 16 Carbon
R29	15K	1	¼	170441500		Painton 92 H.S.
R30	1000	5	¼	170531000		Painton 92 H.S.
R31	1000	5	¼	170531000		Painton 92 H.S.
R32	12K	5	¼	170541200		Painton 92 H.S.
R33	12K	1	¼	170441200		Painton 92 H.S.
R34	12	1	¼	170441200		Painton 92 H.S.
R35	13K	1	¼	170441300		Painton 92 H.S.
R36	1.2M	10	¼	172361200		Erie 16 Carbon
R37	1.2M	10	¼	172361200		Erie 16 Carbon
R38	470	1	¼	170424700		Painton 92 H.S.
R39	10K	1	¼	170441000		Painton 92 H.S.
R40	10K	1	¼	170441000		Painton 92 H.S.

RESISTORS (Cont'd)

Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer & Type	
R41	470	1	¼	170424700			
R42	2200	10	¼	172332200	022-2046	Erie	16 Carbon

RESISTORS VARIABLE.

RV1	2500	10	1	110151040	Painton	316510 W.W.

CAPACITORS.

Cct. Ref.	Value µFd	Tol.	Rating	Solartron Part No.	Manufacturer & Type	
C8	0.01	10	125	221341000	Phillips	C296/AA/A10K. M.Pl.
C9	180pF	2.5	500	210421800	Suflex	H.S. Po.
C10	180pF	2.5	500	210421800	Suflex	H.S. Po.

SEMICONDUCTORS.

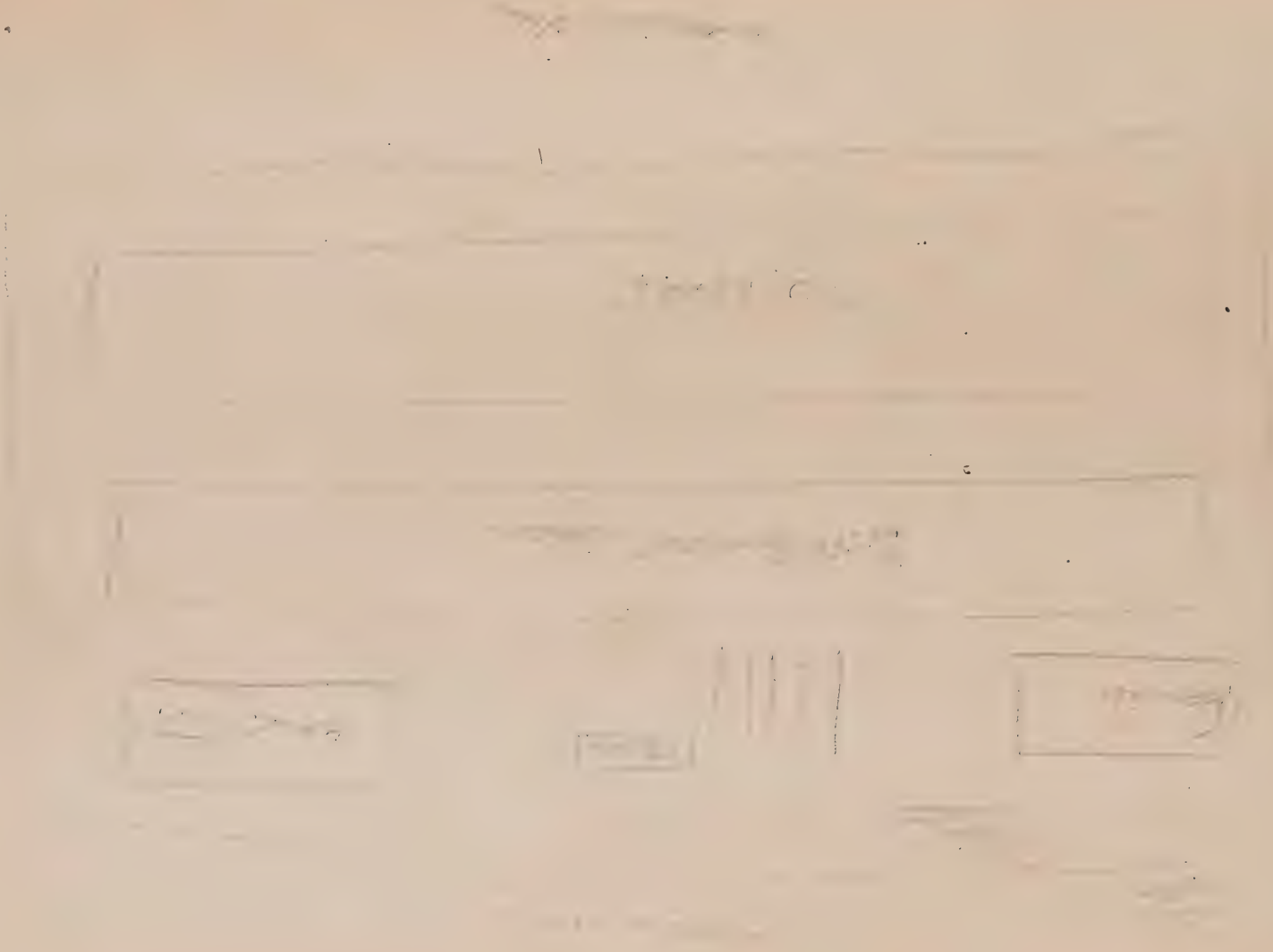
Cct. Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Germanium Diode	300520210	G.E.C.	GEX23
MR2	Germanium Diode	300520210	G.E.C.	GEX23
VT1	Transistor	300550080	G.E.C.	GET875
VT2	Transistor	300550080	G.E.C.	GET875
VT3	Transistor	300550080	G.E.C.	GET875
VT4	Transistor	300550080	G.E.C.	GET875
VT5	Transistor	300550290	Mullard	OC170
VT6	Transistor	300550290	Mullard	OC170

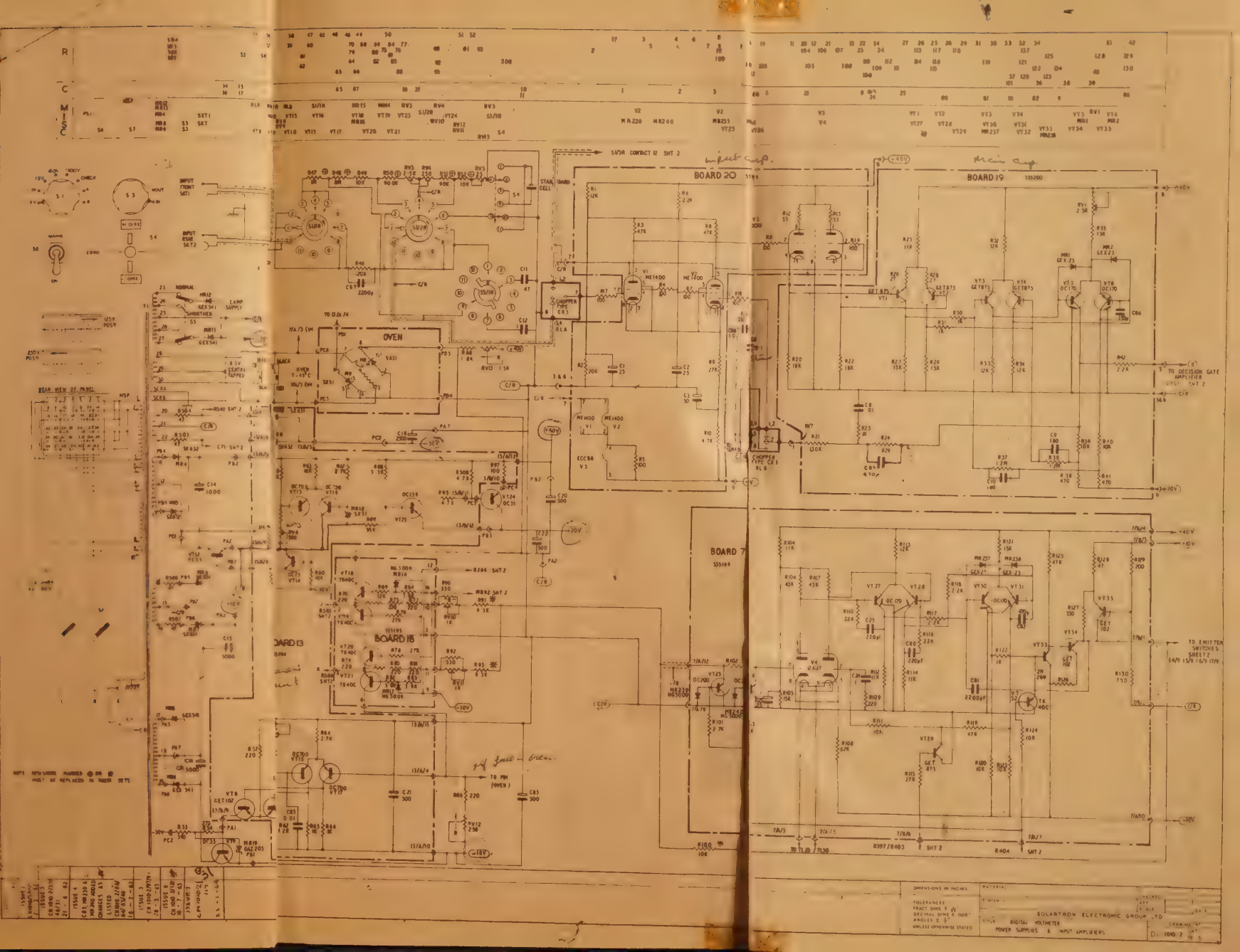
Printed Circuit Board No.20 (Circuit Diagram Sht.1)

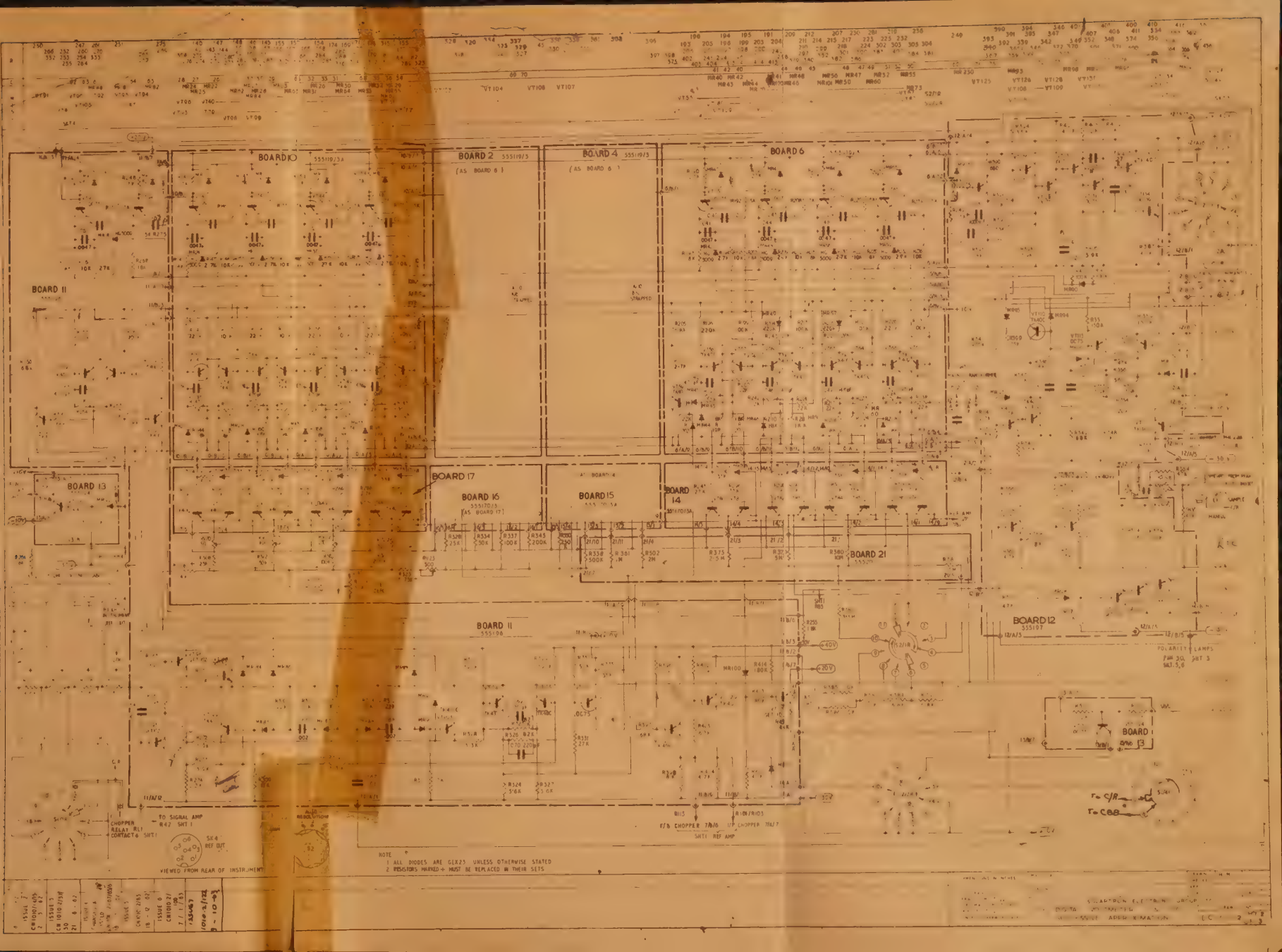
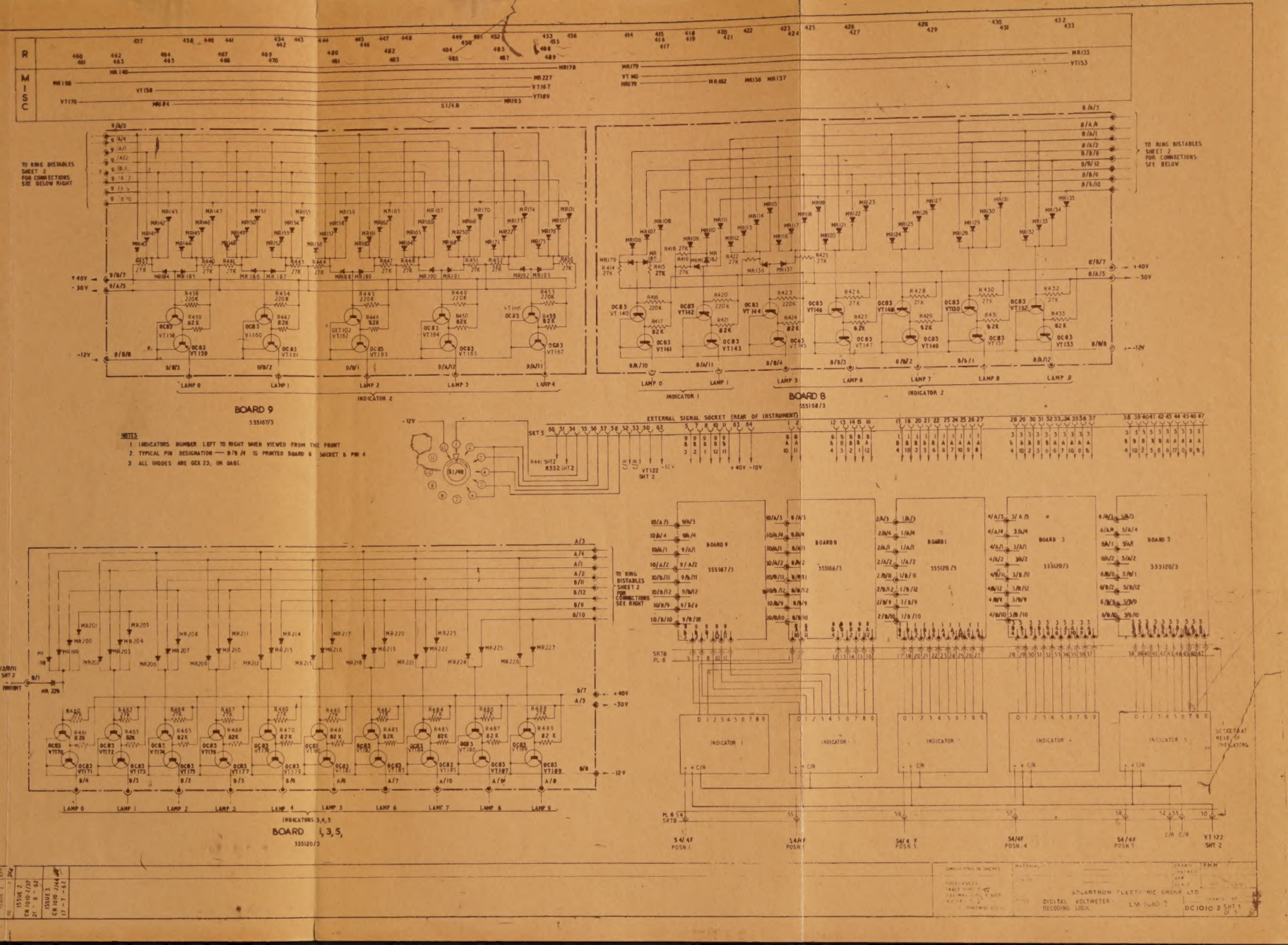
Solartron Part No. 555199

RESISTORS Class Group No. 5905. Country of Origin Code 99.

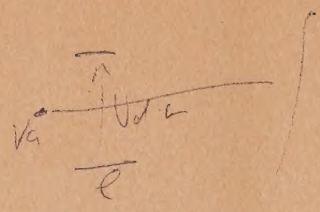
Cct. Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Inter-Service Ref.No.	Manufacturer& Type	
R1	12K	1	¼	170441200			
R2	20K	1	¼	170442000			
R3	47K	5	¼	170544700			
R4	100	10	¼	172321000		Erie	16 Carbon
R5	100	1	½	170721000		Painton	73 H.S.
R6	2200	10	¼	172332200	022-2046	Erie	16 Carbon
R7	100	10	¼	172321000	022-1109	Erie	16 Carbon
R8	47K	5	¼	17054700		Painton	92 H.S.
R9	27K	1	¼	170442700		Painton	92 H.S.
R10	4700	1	¼	170434700		Paintom	92 H.S.




BOARD 20
BOARD 19
BOARD 18
BOARD 13
BOARD 7
OVEN
SOLARTRON ELECTRONIC GROUP LTD
DIGITAL VOLTMETER
POWER SUPPLIES & INPUT AMPLIFIERS


BOARD 10
BOARD 2
BOARD 4
BOARD 6
BOARD 11
BOARD 13
BOARD 17
BOARD 16
BOARD 15
BOARD 14
BOARD 21
BOARD 12
BOARD 1
TO SIGNAL AMP
CHOPPER RELAY RL1 CONTACTS
VIEWED FROM REAR OF INSTRUMENT
NOTE
1 ALL DIODES ARE GEX23 UNLESS OTHERWISE STATED
2 RESISTORS MARKED + MUST BE REPLACED W THEIR SETS

R
MISC
TO RING BISTABLES SHEET 2 FOR CONNECTIONS SEE BELOW RIGHT
TO RING BISTABLES SHEET 2 FOR CONNECTIONS SEE BELOW
+40V
-30V
-12V
LAMP 0
LAMP 1
LAMP 2
LAMP 3
LAMP 4
INDICATOR 2
BOARD 9
555167/3
LAMP 5
LAMP 6
LAMP 7
LAMP 8
LAMP 9
INDICATOR 1
BOARD 8
555168/3
NOTES
1 INDICATORS NUMBER LEFT TO RIGHT WHEN VIEWED FROM THE FRONT
2 TYPICAL PIN DESIGNATION — B/8 /4 IS PRINTED Board 8 SOCKET 8 PIN 4
3 ALL DIODES ARE GEX 23, OR OA81.
EXTERNAL SIGNAL SOCKET (REAR OF INSTRUMENT)
TO RING BISTABLES SHEET 2 FOR CONNECTIONS SEE RIGHT
INDICATORS 3,4,5
BOARD 1, 3, 5,
555120/3
SOCKET AT REAR OF INDICATORS
SOLARTRON ELECTRONIC GROUP LTD
DIGITAL VOLTMETER DECODING LOGIC
LM 1010 2
DC1010 2 SHT 1

$$D = \frac{BLVD}{2Va}$$



MP MASTER
MA24404